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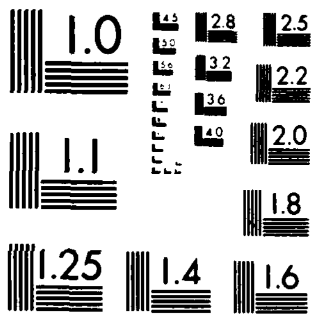

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An Evaluation of an Automatic Cell Detection and Tracking Algorithm

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3 November 1982

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METEOROLOGY DIVISION PROJECT 2781
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AIR FORCE SYSTEMS COMMAND, USAF

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A storm tracking algorithm designed to detect and track fine structure in digitized radar data is evaluated. These fine structures are defined by regions containing values within 3 dB of peaks in reflectivity factor. The algorithm describes storm structure and evolution by correlating these peak regions in time and space

The evaluation consists of a comparison of the algorithm output with raw data and with output from an AFGL algorithm which detects and tracks three-dimensional reflectivity weighted centroids defined by a preselected threshold.

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It is concluded that the algorithm cannot reliably detect and track significant structures within storms when applied to data sets with a temporal resolution of ~6 min and a spatial resolution of 1.0° in azimuth and 0.7° in elevation. The significance of tracking 3 dB peaks is questioned and the implication of defining a larger peak threshold is discussed. The algorithm does track the large features of storms with results similar to the AFGL algorithm. However, it does not run in real time and is not modular, unlike the AFGL algorithm.

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An Evaluation of an Automatic Cell Detection and Tracking Algorithm

1. INTRODUCTION

The large amount of data available from Doppler weather radar systems (for example, reflectivity, radial velocity, and velocity variance fields) make it nearly impossible for an operational forecaster to observe, interpret, and integrate all the data into a forecast product. Many of the algorithms developed for the NEXRAD software package will automate the analysis of Doppler weather radar data in real time and provide useful, easy to interpret products for the operational meteorologist.

As the Technical Evaluation Facility (TEF) for the NEXRAD project, the Air Force Geophysics Laboratory's (AFGL) Ground Based Remote Sensing Branch is developing and evaluating proposed algorithms for the NEXRAD system. In this report we present an evaluation of the Automatic Cell Detection and Tracking Algorithm proposed and developed by Crane[1,2,3,4,5] and Gustafson and Crane,[6,7] as an operational tool.

(Received for publication 3 November 1982)

The Next Generation Weather Radar (NEXRAD) is a joint agency program to develop and acquire a surveillance Doppler weather radar system for the Departments of Commerce (DOC), Defense (DOD), and Transportation (DOT). The NEXRAD system will replace aging DOC and DOD weather radars, and improve severe weather detection capabilities.

(Due to the large number of references cited above, they will not be listed here. See References, page 29.)

We have based the evaluation on an analysis of the timing, accuracy, and limitations of the algorithm assuming:

- a 5-6 min elevation angle sequence (volume scan) repeat time; and
- products will be useful to at least a range of 230 km.

The analysis consists of checks of the algorithm products against both raw data and output from the Automated Real-Time Storm Analysis and Storm Tracking (WEATRK) developed by Bjerkaas and Forsyth.[8]

All the data used in this analysis were archived during the 1979 Joint Doppler Operational Project (JDOP) (Donaldson and Glover[9]) by AFGL's 5-cm radar located at the Doppler Radar Facility of the National Severe Storms Laboratory near Norman, Oklahoma.

2. THE AUTOMATIC CELL DETECTION AND TRACKING ALGORITHM

2.1 Algorithm Overview

The Automatic Cell Detection and Tracking Algorithm (ACDT) was designed to detect and track certain features of precipitation echoes observed in weather radar data. These features are:

- 3 dB peaks defined by contours of reflectivity 3 dBZ below individual peaks in the reflectivity field,
- Volume cells consisting of vertically correlated 3 dB peaks,
- Contour regions defined by one fixed reflectivity value (for example, 30 dBZ) at the lowest available elevation angle,
- Clusters defined as groups of volume cells within a single contour, and with spacings less than some minimum distance.

2.2 Storm Attributes

The following is a discussion of the various attributes which are computed for each of the features listed above.

---

8. Bjerkaas, C.J., and Forsyth, D.E. (1980) An Automated Real-Time Storm Analysis and Storm Tracking Program (WEATRK), AFGL-TR-80-0316, AD A100236.

9. Donaldson, R.J., Jr., and Glover, K.M. (1980) Joint Agency Doppler Technology Tests, AFGL-TR-80-0357, AD A100208.

2.2.1 3 dB PEAKS AND VOLUME CELLS

3 dB peaks are characterized by the attributes listed in Table 1.

These peaks are detected and attributes, compiled and stored for each elevation angle. After a volume scan* is completed the 3 dB peaks are vertically correlated to build three-dimensional structures called volume cells.

The algorithm produces a heirarchy of volume cell types, removes false volume cells, and identifies significant volume cells. Significant cells are characterized as having a high degree of vertical continuity or having high reflectivity and some vertical continuity. Specifically these criteria for significance are: (1) detection on more than 50% of all azimuth scans in a volume scan and more than 70% of the scans below 6 km; or (2) average reflectivity greater than 40 dBZ in more than 30% of the azimuth scans in a volume scan, with some portion below 6 km.

According to Crane,[4] several types of volume cells are evident in the output from this algorithm. These are large mature (significant) cells, young growing cells, and ground clutter which is typically identified by cells that do not move and are close to the surface.

2.2.2 CONTOURS

Since contours are defined as regions enclosed by a preselected reflectivity threshold, they may encompass more than one volume cell. The attributes tallied for each contour region are listed in Table 1.

The motions of the volume cells enclosed by a contour are used to establish tracks for the contour regions, and to provide a directory for the mergers and splits of the contour regions. Estimates of liquid water flux averaged over the area of a fixed contour are useful for a relative evaluation of the contoured regions. The algorithm computes the total water mass flux rates only for observations at the lowest elevation angle to avoid contamination by ice.

2.2.3 CLUSTERS

Closely spaced volume cells are associated as belonging to a cluster, each cluster is tracked and attributes are compiled describing its structure and behavior. The cluster attributes are listed in Table 1. Crane and Hardy[10] state that, at short ranges where the radar beam is sufficiently narrow to resolve the volume cells in a cluster, the cluster will represent active convection. However, at longer ranges, the volume cells in a cluster may not be resolved, in which case the convective element will be detected as a significant cell.

---

*A complete elevation angle sequence from lowest to highest elevation is called a volume scan.

10. Crane, R.K., and Hardy, K.R. (1980) The Hiplex Program in Colby-Goodland Kansas: 1976-1980, Final Report, Document P1552-F, Environmental Research & Technology, Inc., Concord, Massachusetts.

Table 1. List of Attributes Compiled From the Automatic Cell Detection and Tracking Algorithm (after Crane[4])

Function	3 dB Peak	Volume Cell	Cluster	Fixed Contour	Volume Scan Summary
Intensity	•Avg. Reflectivity	•Avg. Reflectivity •Reflectivity at Lowest Ht. •Reflectivity at summit •Peak reflectivity	•Avg. Reflectivity •Peak Reflectivity	•Avg. Reflectivity •Peak Reflectivity	
	•Avg. Tangential Shear	•Avg. Tangential Shear •Peak Tangential Shear	•Avg. Tangential Shear •Peak Tangential Shear		
				•Water Flux	•Water Flux
Location	•Centroid Position	•Centroid Position	•Centroid Position	•Reflectivity Centroid V. Cell Centroid Sig. Cell Centroid*	
Motion		•Velocity of Centroid	•Velocity of Centroid •Velocity of V. Cells	•Velocity of Centroid •Velocity of V. Cells •Velocity of Sig. Cells	
Size	•Area	•Area at Lowest Ht. •Area at Peak Volume		•Area	•Area
Height	•Elevation Angle	•Lowest Height •Height Base •Height Peak •Height Top •Height Summit	•Highest Summit Height	•Highest Summit Height •Avg. Height First Echoes	

Table 1. List of Attributes Compiled From the Automatic Cell Detection and Tracking Algorithm (after Crane[†]) (Cont'd)

Function	3 dB Peak	Volume Cell	Cluster	Fixed Contour	Volume Scan Summary
Structure	• Contour Identity	• Contour Identity • Cluster Identity • Spread of Cell • Centroids	• Contour Identity • Spread of V. Cell Centroids • Correlation of V. Cell Centroids • Orientation of V. Cell Centroids[‡] • No. of V. Cells	• Complex Identity • No. of V. Cells • No. of Clusters • No. of Sig. Cells • Spread of V. Cells • Spread of Clusters • Spread of Sig. Cells • Orientation of V. Cells • Orientation of Clusters • Orientation of Sig. Cells • Correlation of V. Cells • Correlation of Clusters • Correlation of Sig. Cells	• No. of Contours • No. of V. Cells • No. of Sig. Cells and Clusters

[+]V. Cells are Volume Cells

Sig. Cells are Significant Cells

[‡]Correlation of X location (east) vs Y location (north)

3. AN AUTOMATED REAL-TIME STORM ANALYSIS AND STORM TRACKING PROGRAM (WEATRK)

3.1 Algorithm Overview

The following is an abbreviated description of the Automated Real-Time Storm Analysis and Storm Tracking Program (WEATRK).

The WEATRK algorithm defines a storm cell as any region contained within a predetermined reflectivity contour. The storm attributes tabulated by this algorithm include:

- Storm volume,
- Storm mass,
- Mass-weighted centroid,
- Maximum reflectivity and its height,
- Maximum radial velocity at the lowest elevation angle, and
- Maximum spectral variance and its height.

Radar data for this algorithm is acquired via a series of azimuth scans over a volume scan. Reflectivity segments along each radial exceeding a predetermined threshold are identified and correlated azimuthally to define two-dimensional storm cells. After the completion of a volume scan the storm cells are correlated in the vertical to define three-dimensional storms. Any single level feature that is not correlated with any other in the vertical is removed from consideration. The volume centroids are correlated in time, using a [illegible] algorithm. [illegible] squares fit [illegible].

4. CASE STUDIES

[illegible]

[illegible] of the ACDF [illegible] consistency, trajectories, and significant cell attributes. Products from the WEATRK and ACDF were compared.

4.1 Case Study No. 1

The first case study consists of four volume scans recorded between 1555 and 1621 CST on 2 May 1979. These four volume scans are a subset of an eleven volume scan run of the algorithm, and are assessed to be representative of the algorithm's behavior.

The data, for this case, reveals two well-defined storms northwest of the radar at ranges from 120 to 200 km. A cursory glance at Figures 1, 2, 3, and 4 reveals some internal structure in each. The centroid locations of the ACDT contour regions (numbered) and those of the WEATRK storm cells (lettered) are marked on each plot.

Output from the ACDT for Case Study No. 1 can be seen in Tables 2, 3, 4, and 5. The output consists of five parts:

(1) Volume Scan Header Information,

(2) Fixed Contour Region Attributes,

(3) Contour Cell Attributes,

(4) Cluster Attributes, and

(5) Volume Scan Summary.

The attributes for parts 2-5 are listed in Table 1. For a more comprehensive discussion of these attributes and their derivation, see Gustafson and Crane.[7]

From the fixed contour output of Table 2 it can be seen that the ACDT has identified two storms (1 and 2) at the lowest elevation angle (0.4°) along with one other very small feature (3) 217 km from the radar. Six minutes later (Table 3) these same three contours are found along with a new one (4) which is identified as a split from 1 (last column on right). However, with the next sequence (Table 4) the algorithm has declared that contour 4 has merged back with 1 (second to last column on right), and has identified a new cell (5) at a range of 203 km. In the last sequence to be presented here we see that 2 has merged with 1 (Table 5 and Figure 4) and 6 has split from 3.

Although some of the merging and splitting may seem a little artificial (that is, contour region 1 and 4), it is a function of the threshold (30 dBz) used to define the contour regions and the perturbations around that value. Contour region 4 is not readily apparent in Figure 2 due to the smoothing in our contouring routine. It is, however, apparent in the raw data, where two adjacent range gates with reflectivities of 28 and 29 dBz separate two areas of reflectivity greater than 30 dBz. The contoured region between contour regions 1 and 2 (marked x in Figure 1) does not contain a 3 dB peak and is therefore not listed by the algorithm.

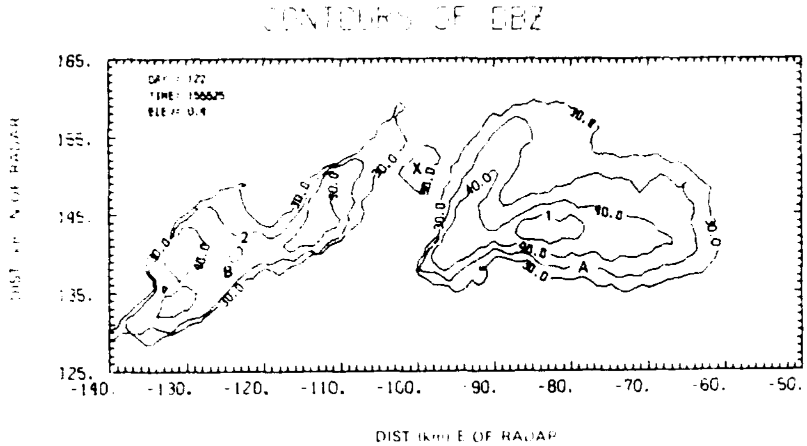

Figure 1. Reflectivity Contour Plot for Volume Scan Beginning at 1555

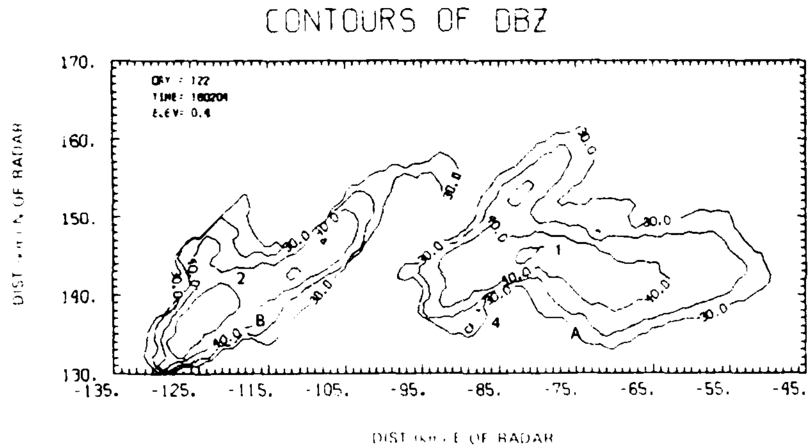

Figure 2. Reflectivity Contour Plot for Volume Scan Beginning at 1601

The contour region centroid locations are determined by averaging the centroid locations of the volume cells enclosed by the contour region. The contour region centroids appear to be located in the correct positions judging from the concurrent lowest elevation contour maps. The peak reflectivities enclosed by the contour regions, and the contour region's speed and direction seen to be reasonable within the resolution of our analysis.

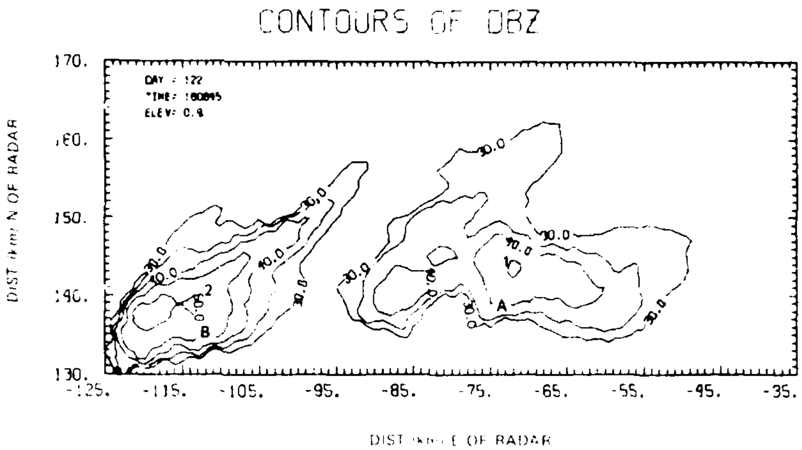

Figure 3. Reflectivity Contour Plot for Volume Scan Beginning at 1800.

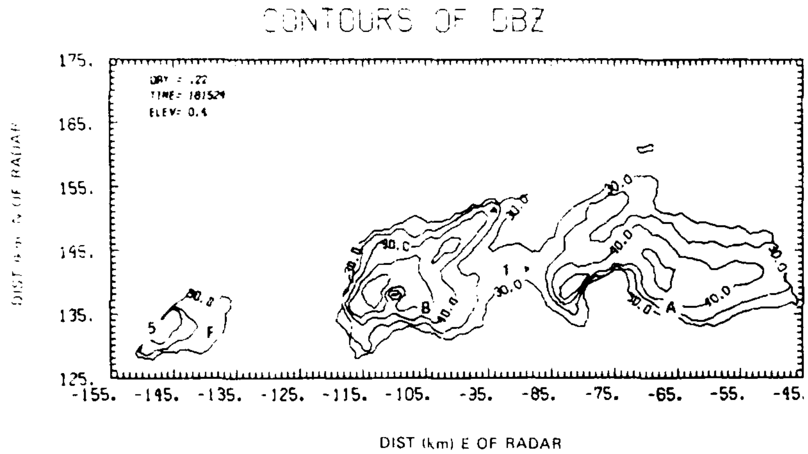

Figure 4. Reflectivity Contour Plot for Volume Scan Beginning at 1815

4.1.1 ACDT-WEATRK PRODUCT COMPARISON

The output statistics for WEATRK storm cells identified in the four volume scans of this case study, and the closest corresponding contour regions from the ACDT are presented in Table 6. The same threshold value was used for determining the WEATRK storm cells and the ACDT contour regions.

Table 2. ACDI Volume Scan Output for Volume Scan No. 1

```
SCAN TIME 122  155507 - 160107    VOL SCAN   1  AZ -137.1 TO 119.8 (DEG)
TRACK REF TIME 1555 7 - 155507    AZM SCAN 10/0 EL -  0.4 TO   6.5 (DEG)


NFN =   10, NVMX =   18

FIXED CONTOUR OUTPUT

   CENTROID AV CELL    Z     N N N SPR SPR  C    WTR AREA VELOCITY NEAR MX PR SP
TRK AZM RNG AZM RNG AV PK    V S C   X   L  R   FLUX XSCN  AV CELL DIST HT ID ID
 NO DEG  KM DEG  KM DB DB    C C L  KM  KM  T   MT/H KKM2 DEG M/S   KM KM NO NO
  1 330 167 329 164 42 47    6 2 1 3.4 9.629C   4.77 C.61  995  999 6.9 12  C  C
  2 319 188 320 188 43 46    4 2 1 3.C 9.2 62   2.54 C.37  995  999 C.C 1C  C  0
  3 329 217 329 217 44 44    1 0 C C.C 0.C  C   0.61 C.C8  995  999 0.C  6  C  0

VOLUME CELL OUTPUT

   CENTROIC -  - Z -  -  HGT  VEAR CELL SPACIAL  (TAN) DOP  RAD RAD CS CN D R R
TRK FST NOR AV PK LW HI L M H EM/S KM/S SPRD  A  (SHR) SPD  VEL SPD TR TR C E E
 NO  KM  KM DB DB DB DB W N I      CLD ID  KM  KM2 (MSK) MSK  M/S M/S NO NO P F
  1 -131 142 42 43 43 43 5 5 5 11.8  2.1 C.CC 9.2  1.4  C.0 -9.5 4.6  0  2 1 1 1
  2* -128 136 39 43 4C 32 4 610 11.8  2.1 C.7816.7  3.4  C.C -0.2 1.6  0  2 7 4 1
  3 -114 143 46 46 46 46 4 4 4 11.8  2.1 C.CC 3.5  1.7  C.0 -9.1 3.3  0  2 2 1 1
  5 -112 142 41 44 44 36 4 5 6 11.8  2.1 C.CC 7.7  C.C  C.0-14.C C.3  1  2 C 2 1
  6* -95 139 40 42 34 42 4 6 7 11.8  2.1 C.CC 6.C  1.7  C.0 -7.3 4.3  2  1 3 3 1
  7  -95 143 43 44 44 42 4 4 5 11.8  2.1 C.CC 8.1  C.C  C.0-14.C C.7  2  1 C 2 1
  8 -112 185 44 44 44 44 6 6 6 11.8  2.1 C.CC10.2  C.C  C.0-14.2 C.C  0  3 C 1 1
  9* -83 143 43 47 47 37 4 4 7 11.8  2.1 C.CC18.3  2.0  C.C -6.9 3.9  0  1 7 3 1
14   -67 137 36 38 35 32 3 4 4 11.8  2.1 C.CC 3.3  1.7  C.0 -4.2 3.5  0  1 4 1 1
15   -8C 137 44 44 44 44 5 5 5 11.8  2.1 C.CC11.5  2.3  C.0 -2.7 4.4  0  1 3 1 1
17*  -89 137 42 45 45 31 5 712 11.8  2.1 1.43 9.2  1.7  C.0 -5.4 6.9  2  1 5 5 1

CLUSTER OUTPUT

   CENTROIC    Z    N SPR SPR ORT CNT VELOCITY SHEAR MX PR SP  CELL   CELL  NO
TRK AZM RNG AV PK   V  X   L  ANG  ID  AV CELL  MSKM HT ID ID  ROT.   DIV.  RD
 NO DEG  KM DB DB   C  KM  KM DEG     EM/S KM/S      KM NC NC  MSKM   MSKM  CS
  1 323 186 41 44   1 C.C C.C   C   2  C.0  C.0  C.C  6  C  C  0.CC   C.C0  0
  2 326 169 42 45   3 1.4 3.6 316   1  C.0  C.C  1.C 12  C  0  0.0C   C.C0  0


VOL HHMM AREA WFLUX NEAR NEIGHBOR  ACT NO NO VELOCITY  TRK CLS CNT C    OVER
SCAN     KKM2 KMT/H CELL CLST CONT VCL CS FC EM/S KM/S  NO CTR CTR C
  1 1555  1.2 10.18  9.4  C.0  C.0  11  4  3 11.8  2.1  18   2   5 C C C C C 0
```

Table 3. ACDI Volume Scan Output for Volume Scan No. 2

```
SCAN TIME 122 - 160149 - 160745   VOL SCAN   2  AZ -169.3 TO 106.1 (DEG)
TRACK REF TIME 16 1 2 - 160149    AZM SCAN 1070 EL -  0.4 TO   6.3 (DEG)

NFN =   10, NVMX =   21

FIXED CONTOUR OUTPUT

  CENTROID AV CELL   Z     N N N SPR SPR  O    WTR AREA  VELOCITY NEAR MX MR SP
TRK AZM RNG AZM RNG AV PK  V S C   X   L  R   FLUX ASCN  AV CELL DIST HT ID ID
 NO DEG  KM DEG  KM DB DB  C C L  KM  KM  T   MT/H KKM2  DEG M/S   KM  KM NO NO
  2 320 185 321 184 43 49  5 2 0 4.0 8.3 49   4.41 0.36  258   15 6.0  9  0  0
  4 327 163 328 160 43 49  2 2 1 0.0 0.0  0   0.05 0.01  314   12 0.0 10  0  1
  3 331 217 330 217 44 44  1 0 0 0.0 0.0  0   0.70 0.10  238   17 0.0  4  0  0
  1 332 165 329 169 44 45  2 0 0 0.0 0.0  0   4.63 0.04  243   10 0.0  3  0  0

VOLUME CELL OUTPUT

  CENTROID -  - Z -  -  HGT  VBAR CELL SPACIAL  (TAN) DOP  RAD RAD UD DN D R F
TRK EST NOR AV PK LW HI L M H EM/S NM/S SPRD  #  (SHR) SPD  VEL SPD TP TR C C C
 NO  KM  KM DB DB DB DB W N I     CLC ID  KM  KM2 (PSF) MSK  M/S M/S NO NO F F L
 1 -123 145 40 40 40 40 3 3 3 17.6 -5.3 0.0011.4  0.0  0.0 13.6 0.0  0  2 0 1 2
 2*-123 137 46 49 49 38 3 5 9 12.8  2.3 5.0011.6  2.2  0.0 -3.1 6.5  0  2 5 4 1
 3 -109 144 44 44 44 44 3 3 3 10.9  2.9 0.0019.4  2.0  0.0 -3.3 3.0  0  2 4 1 2
 5*-106 148 42 45 45 34 3 4 7 13.6  0.8 0.00 7.7  1.2  0.0 -9.3 5.4  0  2 1 3 2
 6* -87 135 43 49 36 34 2 510 17.4 -5.4 0.6510.7  2.1  0.0 -6.8 4.0  2  4 5 4 2
 7  -90 145 44 44 44 44 3 3 3 12.3  3.6 0.0010.1  1.5  0.0 -9.7 3.3  0  1 1 1 2
 8 -107 189 44 44 44 44 4 4 4 13.2  6.1 0.00 5.0  0.0  0.0 13.5 0.0  0  3 0 1 2
 9  -82 145 45 45 45 45 2 2 2  7.6  3.4 0.0010.3  2.5  0.0 -5.0 4.3  0  1 5 1 2
14  -66 138 36 36 36 36 4 4 4  6.5  1.6 0.00 2.5  3.0  0.0 -2.9 5.1  0 -1 5 0 2
15* -81 135 43 47 43 39 4 6 8  2.5 -3.0 0.67 9.5  2.3  0.0 -4.8 3.7  0  411 3 1
17  -86 139 35 35 35 35 4 4 4  9.2  4.1 0.00 6.9  2.4  0.0 -4.9 0.0  0 -1 1 0 2
20 -120 132 40 43 43 32 7 7 8 11.8  2.1 0.0011.6  2.2  0.0 -2.3 7.4  0  2 2 2 1

CLUSTER OUTPUT

   CENTROID   Z    N SFR SFR ORT CNT VELOCITY SHEAR MX MR SF  CELL   CELL  NO
TRK AZM RNG AV PK  V  X   L  ANG  ID  AV CELL MSKM HT ID ID  RCT.   DIV.  RC
 NO DEG  KM DB DB  C  KM  KM DEG     EM/S NM/S      KM NO NO MSKM   MSKM  CS
  2 327 161 43 49  1 0.0 0.0  0   4 21.1-10.5  2.1 10  0  0  0.00   0.00  0

VCL HHMM AREA WFLUX NEAR NEIGHBOR  ACT NO NO VELOCITY  TRK CLS CNT G   OVER
SCAN     KKM2 KMT/H CELL CLST CONT VCL CS RC EM/S NM/S  NO CTR CTR C
  2 1601  1.3 12.19  9.6  0.0  0.0  12  4  3 11.8  2.1  21   2   4 0 0 0 0 0 0
```

Table 4. ACDT Volume Scan Output for Volume Scan No. 3

```
SCAN TIME 122  160827 - 161321   VOL SCAN   3  #2 -145.4 TO 144.3 (DEG)
TRACK REF TIME 16 742 - 160827   AZM SCAN  8/0 EL -  0.4 TO   5.8 (DEG)

NFN =     8, NVMX =    34
```

FIXED CONTOUR OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	AV CELL AZM DEG	AV CELL RNG KM	Z AV DB	Z PK DB	N V C	N S C	N C L	SFR X KM	SFR L KM	O R T	WTR FLUX MT/H	AREA XSCN KKM2	VELOCITY AV CELL DEG	VELOCITY M/S	NEAR DIST KM	MX HT KM	MR ID NO	SP ID NO
2	321	181	322	179	45	51	5	2	0	3.5	8.0	42	6.73	0.37	257	8	7.4	[illegible]	0	0
5	310	203	310	203	36	41	2	0	0	0.0	0.0	0	0.40	0.08	999	999	0.0	7	0	0
3	332	216	333	217	37	38	2	0	0	0.0	0.0	0	0.48	0.11	274	15	0.0	6	0	0
1	333	162	331	161	42	49	8	3	1	5.3	5.3	44	4.08	0.60	256	10	4.9	9	4	0

VOLUME CELL OUTPUT

TRK NO	CENTROID EST KM	CENTROID NOR KM	Z AV DB	Z PK DB	Z LW DB	Z HI DB	HGT L W	HGT M N	HGT H I	VBAR EM/S	CELL NM/S CLD ID	SPATIAL SPRD KM	SPATIAL A KM2	(TAN) (SHR) (MSK)	DCP SFD MSK	RAD VEL M/S	RAD SPD M/S	CS TR NO	CN TR NO	C	R	F
1	-115	144	31	31	31	31	6	6	6	18.1	0.6	0.00	3.5	2.4	0.0	-11.1	6.0	0	-2	1	0	2
2*	-119	138	47	51	51	40	4	5	9	11.3	2.9	0.36	12.5	1.9	0.0	-7.2	2.8	0	2	5	4	2
3	-110	145	44	44	44	44	4	4	4	4.2	1.5	0.00	3.4	2.5	0.0	-1.5	3.5	0	2	2	0	2
5*	-101	149	39	41	41	32	4	5	7	13.4	1.1	0.00	3.7	1.7	0.0	-5.4	2.9	0	2	3	2	2
6	-83	137	31	31	31	31	3	3	3	12.4	1.1	0.00	1.5	1.3	0.0	1.9	0.0	0	1	1	0	2
7	-83	148	38	38	38	38	4	4	4	14.2	5.2	0.00	12.0	1.9	0.0	-4.1	5.3	0	1	2	1	2
~~8~~	-100	188	38	38	38	38	5	5	5	14.5	1.8	0.00	15.2	0.0	0.0	-13.8	0.6	0	-3	-0	1	2
9	-73	146	42	44	44	40	4	4	5	15.2	2.4	0.00	7.3	1.9	0.0	-7.2	3.2	3	1	3	2	2
14	-60	139	37	37	37	37	4	4	4	11.5	3.1	0.00	4.3	1.8	0.0	-6.0	1.2	0	-1	2	0	2
15*	-79	134	46	49	49	39	5	6	9	3.9	-2.5	1.02	6.9	2.1	0.0	-5.[illegible]	4.1	[illegible]	111		4	2
17*	-86	139	43	46	44	38	4	6	9	4.6	1.4	1.64	6.7	1.4	0.0	-9.4	4.8	0	1	3	5	2
20	-118	133	42	43	43	43	6	6	6	8.0	2.5	0.00	5.0	3.2	0.0	-2.6	3.6	0	-2	2	[illegible]	[illegible]
21	-157	130	38	41	41	31	5	5	7	11.8	2.1	0.00	2.3	0.0	0.0	-14.4	0.5	0	5	0	2	1
22	-113	139	50	50	50	50	4	4	4	11.8	2.1	0.00	10.6	1.7	0.0	-3.6	5.4	0	2	5	1	1
23	-98	196	37	37	37	37	6	6	6	11.8	2.1	0.00	4.1	0.0	0.0	-14.0	0.0	0	3	0	1	1
24	-71	144	45	45	45	45	3	3	3	11.8	2.1	0.00	7.6	1.8	0.0	-5.9	0.6	0	1	1	1	1
25	-151	131	34	36	36	31	5	5	7	11.8	2.1	0.00	4.4	1.4	0.0	-5.8	3.8	0	5	1	1	1
27	-113	130	37	40	35	34	5	7	8	11.8	2.1	0.00	14.3	1.4	0.0	-5.1	6.4	0	2	2	2	1
~~30~~	~~-73~~	~~131~~	36	38	38	35	4	6	9	11.8	2.1	0.00	10.0	1.6	0.0	-5.9	7.6	0	1	4	1	1
32	-76	140	36	38	38	35	6	7	8	11.8	2.1	0.00	6.8	1.7	0.0	-5.8	5.4	0	1	1	2	1
33	-59	132	32	32	32	32	5	5	5	11.8	2.1	0.00	7.1	2.1	0.0	-4.8	0.9	0	0	2	0	1

CLUSTER OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	Z AV DB	Z PK DB	N V C	SFR X KM	SFR L KM	ORT ANG DEG	CNT ID	VELOCITY AV EM/S	VELOCITY CELL NM/S	SHEAR MSKM	MX HT KM	MR ID NO	SF ID NO	CELL ROT. MSKM	CELL DIV. MSKM	NO RD CS
3	333	164	42	44	1	0.0	0.0	0	1	20.2	1.6	1.9	5	0	0	0.00	0.00	0

VOL SCAN	HHMM	AREA KKM2	WFLUX KMT/H	NEAR NEIGHBOR CELL	NEAR NEIGHBOR CLST	CCNT	ACT VCL	NO CS	NC FC	VELOCITY EM/S	VELOCITY NM/S	TRK NO	CLS CTR	CNT CTR	6 C	OVER				
3	1607	1.3	13.52	6.0	13.7	0.0	21	5	4	11.0	1.8	34	3	5	0	0	0	0	0	0

Table 5. ACDT Volume Scan Output for Volume Scan No. 4

SCAN TIME 122 161506 - 162103 VOL SCAN 4 AZ ~~-141.9 TO 110.6 (DEG)~~
TRACK REF TIME 1613 3 - 161506 AZM SCAN 9/C EL - 0.3 TO 6.6 (DEG)

NFN = 9, NVMX = 44

FIXED CONTOUR OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	AV CELL AZM DEG	AV CELL RNG KM	Z AV DB	Z PK DB	N V C	N S C	N C L	SPR X KM	SPR L KM	C R T	WTR FLUX MT/H	AREA XSCN KKM2	VELOCITY AV DEG	VELOCITY CELL M/S	NEAR DIST KM	MX HT KM	MR ID NO	SP ID NO
5	311	199	310	202	39	45	2	1	1	0.0	0.0	0	0.97	0.14	271	6	0.0	7	0	0
6	332	212	332	212	34	34	1	0	0	0.0	0.0	0	0.06	0.02	297	7	0.0	5	0	3
1	326	170	326	168	44	52	18	3	3	7.5	18.1	65	11.55	1.08	250	13	4.6	11	2	0
3	335	221	335	221	35	35	1	0	0	0.0	0.0	0	0.06	0.02	237	17	0.0	6	0	0

VOLUME CELL OUTPUT

TRK NO	CENTROID EST KM	CENTROID NOR KM	Z AV DB	Z PK DB	Z LW DB	Z HI DB	HGT L W	HGT M N	HGT H I	VBAR EM/S	CELL NM/S OLD ID	SPACIAL SPRD KM	SPACIAL A KM2	(TAN) (SHR) (MSK)	COP SPD MSK	RAD VEL M/S	RAD SPE M/S	CS TR NO	CN TR NO	C E P	R E F	F E L
2*	-114	139	48	52	52	47	4	5	8	11.7	2.6	0.00	10.2	1.9	0.0	-7.0	7.9	4	1	1	3	2
3	-104	147	40	40	40	40	4	4	4	9.5	3.6	0.00	9.5	4.3	0.0	-3.4	0.0	0	1	1	0	2
5	-93	152	32	32	32	32	6	6	6	17.5	5.3	0.00	9.2	0.0	0.0	-14.5	0.0	0	-1	0	1	2
6*	-80	140	47	51	51	44	3	4	6	10.3	4.0	0.00	5.5	3.0	0.0	-4.2	3.6	5	1	4	3	2
7	-76	153	36	36	36	36	4	4	4	17.4	9.2	0.00	15.0	0.0	0.0	-13.8	0.0	0	1	0	1	2
8	-98	187	34	34	34	34	5	5	5	9.7	-1.3	0.00	3.8	0.0	0.0	-13.9	0.0	0	6	0	1	2
9	-71	149	40	43	43	36	4	4	5	10.0	5.2	0.00	2.1	0.0	0.0	-12.6	1.8	0	1	0	2	2
15*	-75	136	44	48	48	33	5	6	10	8.4	1.7	0.69	7.4	1.9	0.0	-5.4	5.8	5	1	7	5	2
17	-83	141	40	41	39	41	5	6	7	6.3	4.3	0.00	4.2	0.0	0.0	-14.1	0.2	5	1	0	2	2
20	-114	135	41	42	42	42	4	4	4	8.5	3.5	0.00	3.7	4.2	0.0	-0.5	0.0	0	1	1	0	2
22	-109	137	49	49	49	49	4	5	5	11.6	-2.3	0.00	8.9	2.1	0.0	-4.2	6.6	4	1	1	2	2
23	-92	200	35	35	35	35	6	6	6	13.5	6.5	0.00	5.5	0.0	0.0	-14.5	0.0	0	3	0	1	2
24	-63	144	41	41	41	41	3	3	3	16.1	0.3	0.00	4.0	1.9	0.0	-11.9	0.0	0	1	1	0	2
25	-149	131	42	45	45	34	5	5	7	8.5	0.7	0.00	9.7	1.6	0.0	-8.7	3.2	6	5	2	2	2
27	-109	133	47	49	46	49	5	7	7	10.2	5.2	0.00	2.6	2.5	0.0	-4.1	3.9	7	1	9	2	2
30	-69	135	39	39	39	39	4	4	4	11.5	6.5	0.00	4.1	2.0	0.0	-5.9	1.2	0	-1	2	0	2
32	-70	142	39	39	39	39	3	3	3	13.7	3.0	0.00	2.7	2.5	0.0	-6.3	2.5	0	1	2	0	2
33	-57	132	33	33	33	33	6	6	6	6.7	2.2	0.00	2.7	3.8	0.0	-7.4	0.0	0	0	1	0	2
~~34~~	~~-161~~	~~127~~	~~33~~	~~34~~	~~34~~	~~33~~	~~5~~	~~6~~	~~7~~	~~11.0~~	~~1.8~~	~~0.00~~	~~8.9~~	~~0.0~~	~~0.0~~	~~-7.1~~	~~7.1~~	~~0~~	~~5~~	~~0~~	~~2~~	~~1~~
35	-113	129	39	39	39	39	4	4	4	11.0	1.8	0.00	3.6	0.0	0.0	-15.3	0.0	0	1	0	1	1
36	-101	147	47	47	47	47	4	4	4	11.0	1.8	0.00	3.4	2.7	0.0	-6.9	0.0	0	1	0	1	1
37	-97	141	34	34	34	34	4	4	4	11.0	1.8	0.00	6.5	2.5	0.0	-6.5	2.3	0	1	3	0	1
38	-157	123	32	32	32	32	7	7	7	11.0	1.8	0.00	6.3	0.0	0.0	-14.4	0.0	0	0	0	1	1
40*	-108	132	46	50	50	36	5	6	10	11.0	1.8	0.09	9.4	1.9	0.0	-6.3	4.6	7	1	2	4	1
42	-114	137	42	45	45	33	7	8	11	11.0	1.8	0.00	9.9	0.0	0.0	-9.3	6.6	4	1	0	3	1
44	-65	132	36	39	39	32	7	7	8	11.0	1.8	0.00	6.4	2.1	0.0	-4.8	5.4	0	1	4	2	1

CLUSTER OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	Z AV DB	Z PK DB	N V C	SPR X KM	SPR L KM	ORT ANG DEG	CNT ID	VELOCITY AV EM/S	VELOCITY CELL NM/S	SHEAR MSKM	MX HT KM	MR ID NO	SF ID NO	CELL ROT. MSKM	CELL DIV. MSKM	NO RD CS
4	321	178	47	52	3	0.9	2.5	291	1	11.7	-1.4	1.8	11	0	0	0.00	0.00	2
5	330	161	45	51	3	0.2	4.1	304	1	9.2	5.5	2.3	10	0	0	-0.47	4.79	3
6	311	199	42	45	1	0.0	0.0	0	5	6.3	-0.1	1.6	7	0	0	0.00	0.00	0
7	321	172	47	50	2	0.0	0.0	0	1	9.0	7.2	2.3	10	0	0	0.00	0.00	0

VOL SCAN	MHMM	AREA KKM2	WFLUX KMT/H	NEAR CELL	NEIGHBOR CLST	CONT	ACT VCL	NO CS	NO FC	VELOCITY EM/S	VELOCITY NM/S	TRK NO	CLS CTR	CNT CTR	C	OVER
4	1613	1.5	15.71	5.2	0.0	0.0	26	4	2	11.3	3.6	44	7	6	0	0 0 0 0 0

Table 6. ACDT-WEATRK Product Comparison for Case Study No. 1

Algorithm	Contour Region No. or Storm Cell No.	Azimuth	Range (KM)	Max Height (KM)	Centroid Direction	Speed (M/S)	Maximum Reflectivity	Verified Reflectivity
Time 1555								
ACDT	1	330	167	12	-	-	47	50
WEATRK	1	330	160	10.4	-	-	51	
ACDT	2	319	188	10	-		46	
WEATRK	2	318	186	8.6	-	-	46	46
WEATRK	3	324	184	3.6	-		46	
ACDT	3	329	217	6	-	-	44	48
WEATRK	4	330	214	4.6	-		48	
Time 1601								
ACDT	4	237	163	10	314	12	[illegible]	
ACDT	1	332	165	3	296	12	[illegible]	[illegible]
WEATRK	1	331	156	10.4	243	10	52	
ACDT	2	320	185	9	258	15	[illegible]	[illegible]
WEATRK	2	320	180	10.2	284	22	53	
ACDT	3	331	217	4.9	238	17	44	
WEATRK	4	332	214	4	236	20	48	
Time 1608								
ACDT	1	333	162	9	258	10	[illegible]	[illegible]
WEATRK	1	331	154	10.0	288	9	[illegible]	
ACDT	2	321	181	9	257	8	51	[illegible]
WEATRK	2	321	176	9.8	279	14	54	
ACDT	3	332	216	6	274	15	38	[illegible]
WEATRK	4	333	212	4.9	243	16	40	
ACDT	5	310	203	7	-	-	41	[illegible]
WEATRK	5	311	200	4.4	-	-	42	

Table 6. ACDT-WEATRK Product Comparison for Case Study No. 1 (Contd)

Algorithm	Contour Region No. or Storm Cell No.	Azimuth °	Range (kM)	Max Height (kM)	Centroid Direction	Speed (M/S)	Maximum Reflectivity	Verivied Reflectivity
ACDT	1	326	170	11	250	13	52	
WEATRK	2	322	170	11.1	286	16	55	55
WEATRK	1	334	152	9.8	277	10	54	
ACDT	5	311	199	7	271	6	45	
WEATRK	5	309	202	7.2	44	12	42	46
WEATRK	6	313	194	3.9	-	-	46	
ACDT	3	335	221	6	327	17	35	
ACDT	6	332	212	7	297	7	34	

Before the data are compared, it is necessary to discuss the differences in the algorithms' processing schemes. Since WEATRK tracks three-dimensional storm cells, that are large relative to the volume cells tracked by ACDT, the centroid position of the storm cell will be different from that of the contour region given by ACDT.

The centroid locations of the various ACDT contour regions, and WEATRK storm cells are plotted in Figures 1, 2, 3, and 4. Although the centroid locations of the WEATRK storm cells and the ACDT contour regions are derived differently they both represent three-dimensional reflectivity-weighted entities, and are hard to locate on two-dimensional single elevation angle plots. In viewing these figures it must be noted that the contoured data field is slightly smoothed by the coordinate conversion and plotting routines.

Table 6 reveals that the maximum reflectivity values reported by WEATRK are slightly higher than those from ACDT. This is due to the two range gate averaging performed by the ACDT.

The maximum echo heights reported by the ACDT are generally close to those reported by WEATRK. There are, however, some differences of more than 1.5 km (that is, contour region No. 1 at 1555, contour region No. 5 at 1608). These might be explained by the ACDT finding a 3-dB peak in the next higher elevation azimuth scan that does not exceed the WEATRK criterion of reflectivity above threshold in 14 contiguous range gates.

The velocity difference between the ACDT contour region centroids and the WEATRK storm cell centroids shows a bias of +11.8° and -1.7 m sec. These are acceptable since the centroid positioning error for this data is ± 1.5 km.

The net effect of these differences is negligible as both the contour regions and the storm cells propagate in approximately the same direction. Figure 5 is the contour plot for the first volume scan of this case study, with the centroid locations of the ACDT contour regions and WEATRK storm cells for all four volume scans labeled. It is interesting to note the apparent reversal in the motion of contour region 1 at 1615. This is obviously due to the merging of contour regions 1 and 2.

4.1.2 SPATIAL CORRELATIONS

Further analysis of the ACDT output reveals that an average 52% of all volume cells are detected at only one height. Out of the nine volume cells tracked over all four volume scans, only volume cell 2 was detected at more then one height at all times.

Some of these "single height" volume cells appear to be oriented in such a way as to suggest that they might be vertically correlated with neighboring "single height" cells (for example, cells 9 and 15 at 1601, 6 and 17 at 1608). This might imply we have reason to doubt the validity of the vertical correlation function used in the

algorithm. The following comments from Gustafson and Crane,[7] page 7, concur with this reasoning: "Relaxation of the height separation criteria of the association logic to accommodate large elevation steps could cause invalid associations such as that of an immature cell at a mid-level with the cirrus overhang from a nearby mature storm. Clearly a trade-off is required; thus, the weight of the height component of the association function is defined such that a separation of between 2.5 and 3.0 km will make an association difficult (that is, require close agreement between the other components), and a separation greater than 3 km will cause the association to be rejected."

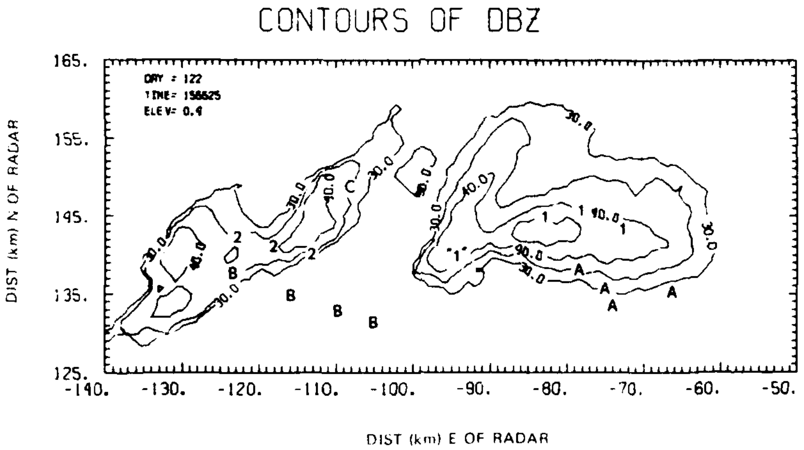

Figure 5. ACDT Contour Region (numbered) and WEATRK Storm Cell (lettered) Centroid Locations for Volume Scans 1-4. Motion is from left to right, location marked "1" is centroid location of merged contour regions 1 & 2 in Volume Scan No. 4

The data were collected at 0.7° elevation angle steps; thus by using the 4/3 earth beam refraction correction we find the height difference between elevation angles is 2.5 km at a range of 150 km and 4.0 km at 230 km.

Another factor that may be contributing to the vertical correlation problem is that the height computations for some features appear to be wrong. Although most of the heights are correct within the resolution of the algorithm (1 km), there are a few cases where the height given for a volume cell is in error even when truncated to the nearest kilometer. Table 7 illustrates this discrepancy.

In studying the cluster output for this case it is apparent that 83% of the clusters are not correlated in time, and no single cluster is tracked throughout the entire 4 volume scans.

Table 7. Comparison of Height Estimates of Selected Volume Cells From ACDT and 4/3 Earth Correction for the Lowest Two Elevation Angles (α)

Cell No.	Volume Scan No.	Range	ACDT Height	4/3 Earth $\alpha = 0.4°$	4/3 Earth $\alpha = 1.3$
1	1	194	5	3.9	6.9
9	1	167	4	3.1	5.6
9	2	167	2	3.1	5.6

Figure 6 is a plot of the positions and trajectories of the volume cells in contour No. 1 starting with volume scan No. 1. These volume cell tracks all look plausible, although it is interesting to note the movement of volume cell 16 around 17 and the almost complete reversal of direction of cell 15.

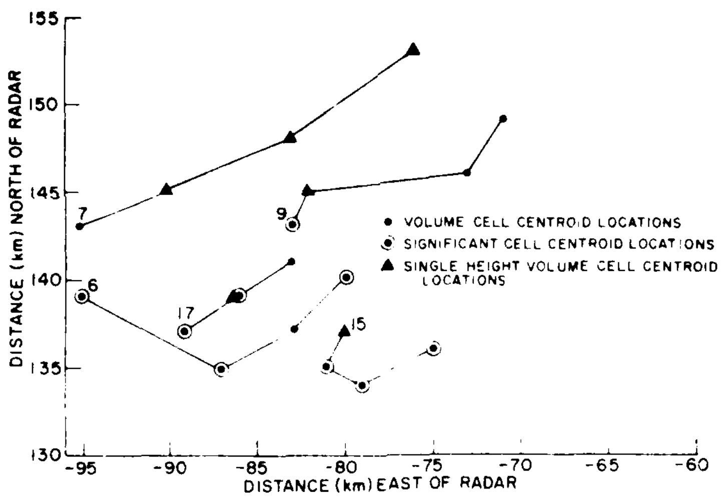

Figure 6. ACDT Volume Cell Centroid Trajectories for Contour Region No. 1. For volume scans 1-4

Figure 7 is a plot of the vertical extent of selected volume cells throughout the period of interest. This diagram illustrates the rapid structural changes in several volume cells. Cells 6 and 17 seem to alternately lose and gain their significance in volume scans 2 through 4. Cells 7 and 9 behave erratically between volume scans 1 and 2, going from a multi-height entity to a single height entity at

a lower elevation. Volume cell No. 5 is an example of a short lived significant cell, one which does not decay the way one might expect, that is, with reflectivity gradually lowering in time. The behavior of volume cell 20 on the other hand might be indicative of a decaying cell. Volume cell numbers 1, 3, 8 are examples of single height cells that are tracked over several volume scans. Volume cell No. 2 is an example of a relatively long lived significant cell. Volume cell 15 could be an example of a growing storm cell.

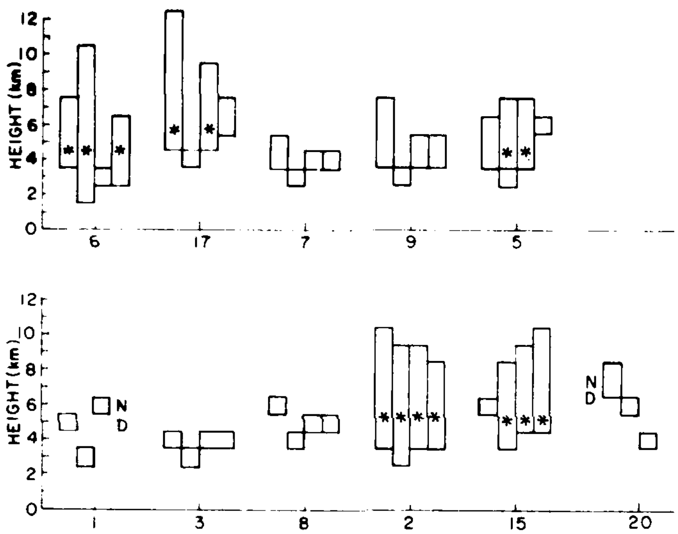

Figure 7. Volume Cell Vertical Extent for Volume Scans 1-4. (* signifies significant cells, ND - Volume Cell not defined)

4.1.3 TEMPORAL CORRELATIONS

One check of the reliability of a tracking algorithm is the examination of the ratio of the nearest neighbor distance between cells and the distance each cell travels between observation times. This ratio should be greater than 1 to have any meaningful significance. Another parameter to consider is the ratio of the nearest neighbor distance and the average cell diameter to give another indication of possible cell overlap. These ratios were computed for all the nearest neighbor volume cells within a contour region.

Table 3 contains a listing of these ratios for all the nearest neighbor cells that had a lifetime of more than two volume scans (~ 12 min).

Table 8. Compilation of Volume Cell Overlap Ratios, for Nearest Neighbor Cells

Time	Contour	Cell Group	d/st	d/2r
1601	2	1-2	1.5	2.2
	2	*2-20	1.2	1.5
	2	*3-5	1.2	1.2
	1	*7-9	2.1	2.2
	4	*6-15	1.7	1.7
1608	1	*7-9	0.3	0.4
	1	*6-17	1.1	1.9
	1	6.15	2.2	2.4
	2	*3-5	2.0	2.5
	2	*1-20	2.1	3.7
1615	1	*2-20	2.2	1.3
	1	*6-17	0.9	1.3
	1	*30-32	1.4	0.1
	1	15-32	1.9	3.1
	1	24-30	2.0	4.8
	1	*22-27	0.9	1.4
	1	*9-32	1.6	4.1
	1	*7-9	1.1	1.9
	1	3-22	2.8	3.2
			$\overline{\frac{d}{st}} = 1.4$	$\overline{\frac{d}{2r}} = 1.9$

*Cell groups are counted twice in overall average (that is, is, cell No. 2 is the nearest neighbor to cell No. 20 and vice versa)

The following variables are used to compute these ratios:

d = Nearest neighbor separation distance (km),

$\bar{s}$ = Average cell speed over the volume scan (km/s),

t = Volume scan time (s),

r = Average cell radius (km).

The overall average for the nearest neighbor distance over the distance each cell travels between observation times $(\frac{d}{st})$ is 1.4, the overall average for the ratio of nearest neighbor distance to cell diameter $(\frac{d}{2r})$ is 1.9. The error in determining cell position due to the radar beam width is ± 1.5 km at a range of 175 km. This positioning error results in an uncertainty of ± 3.0 in $\frac{d}{st}$ and ± 1.8 $\frac{d}{2r}$. Considering these uncertainties, it is obvious that the above ratios are not large enough to demonstrate that the algorithm can distinguish between adjacent volume cells in subsequent volume scans.

4.2 Case Study No. 2

The second case study consists of four volume scans, recorded from 1534-1557 CST on 10 April 1979. The thunderstorm observed at this time extended in a complex band from the northeast to southwest of the radar. Figure 8 is a contour plot of a small section of this band. The closest identifiable 30-dBz contour was at a range of 20 km.

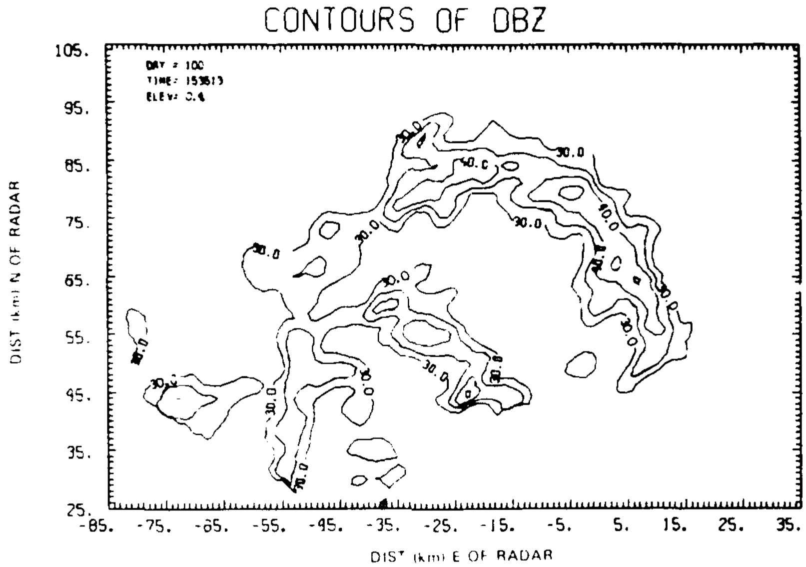

Figure 8. Reflectivity Contour Plot for Volume Scan Beginning at 1534

A synopsis of the ACDT output (Appendix A) can been seen in Table 9. The high number of contours and volume cells in Table 6 confirms the complex nature of the storm system on this day. The number of fixed contour regions for the time period of interest never drops below 33, yet only three of these are correlated throughout all four volume scans. On the average 77% of all contour regions are not temporally correlated.

The number of volume cells detected for each volume scan is also very large. It was found that on average 49% of all volume cells were uncorrelated in time and 55% were uncorrelated vertically (that is, detected at only one height). There were 21 volume cells that were followed for the entire time, yet only four of these (numbers 42, 53, 126, 131) had vertical continuity at all times. Considering this it is not surprising that 56% of the clusters in this case showed no temporal continuity. This case was run again with 35 dBz as a threshold; the effect of which was

to reduce the number of contour regions from 39 to 32 without changing significantly the number of volume cells that were uncorrelated in time. In comparison, when the WEATRK algorithm was run with a 35-dBz threshold over the same data, it detected 12 storm cells, and tracked 8 of these throughout this time period. It must be noted, that WEATRK only lists the attributes for what it determines to be the 12 most significant storm cells.

In addition, ACDT appears to have difficulties in identifying and tracking significant cells in this case. There are 40 significant cells identified over the period of interest, yet only one of these (number 126) is detected in all four volume scans. Over all, 88% of the significant cells are not correlated in time.

Table 9. Synopsis of the ACDT Algorithm Output for 1534-1557 (CST) on 10 April 1979

Volume Scan No.	No. of Contour Regions Total	No. of Contour Regions New	No. of Volume Cells Total	No. of Volume Cells New	No. of Clusters Total	No. of Clusters New
1	39	-	148	-	24	-
2	37	27	148	77	19	8
3	34	24	113	51	18	11
4	33	29	140	72	23	15

5. SUMMARY AND CONCLUSIONS

The ACDT behaves as designed, that is, it locates 3 dB peaks, defines contours, groups clusters, and tracks these entities. Although not all of the individual 3 dB peaks can be identified in the contour plots presented in this report, they can be located in the higher resolution raw data.

It is apparent that the algorithm is experiencing several problems when applied to our data sets; it has however, proved to yield good results using 3 to 5 min volume scan repeat time with greater vertical resolution (Crane and Hardy,[10] Crane[11]). It is thought that several of the problems in this analysis such as, uncorrelated volume cells, single height cells, and uncorrelated significant cells are due to inadequate temporal (6-min volume scan repeat time) and/or inadequate vertical resolution (as much as 2.8 km at ranges of 230 km).

11. Crane, R.K. (1976) Radar Detection of Thunderstorm Hazards for Air Traffic Control, Vol. I Storm Detection, Project Report ATC-67, Vol. I, MIT Lincoln Laboratory, Lexington, Massachusetts, FAA-RD-76-52; AD A032732.

Previous studies have only been concerned with data out to 150 km (Crane and Hardy[10]). Gustafson[12] concurs with these speculations regarding possible areas of algorithm breakdown.

An average 50% of the volume cells detected by the ACDT are not correlated with another volume cell in the next volume scan. Yet, at the same time the ACDT tracked some single height volume cells over the entire four volume scans of case study No. 1 (that is, cells 3 and 8).

The association of volume cells of considerable vertical extent (that is, > 4 km) in one volume scan to those of little vertical extent (that is, 1 km) in the next volume scan (that is, 6, 17, 9, 5 in Figure 7) causes us to question the ability of the algorithm to vertically correlate the 3-dB peaks and to adequately track these volume cells.

The ratio of the nearest neighbor distance to the distance an average volume cell travels between observation times is shown to be small when compared to the relative error in determining the volume cell positions. This might explain the difficulties that the ACDT had with cell tracking.

The fact that ACDT sometimes detected higher storm cell peaks is not thought to be a significant advantage over WEATRK as these higher peaks are small (less than 14 range gates) in horizontal extent.

Crane[3] found the average lifetime for a significant cell to be approximately 30 minutes. We found the average significant cell to have a lifetime close to 10 minutes.

Crane and Hardy[10] state that the volume cell clusters may be the most important feature for analyzing storm structure. In our analysis 69% of the clusters were uncorrelated in time, suggesting that they may not be quite as important here. This is obviously a product of the difficulties the ACDT has with the elements within the clusters, namely the volume cells.

Finally, a few comments on the software itself. It was found that the subroutines for the ACDT contain a substantial amount of residual developmental code. The subroutines are not modular, hence it is difficult to make changes to the processing scheme without altering the code in several subroutines. The algorithm currently runs at approximately two times real time for the simple case and three times real time for the more complex case. However, if this algorithm were to be used operationally, an entirely new software package would be needed; preferably a modular one designed for speed and efficiency.

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12. Gustafson, G. B. (1982) Personal communication.

It is apparent that more work must be done to determine what radar data processing methods would yield the best results for a given meteorological scale. WEATRK tracks the large scale features of a storm complex, while ACDT tracks much smaller entities to presumably yield a description of the internal structure of a storm complex. The ACDT was initially developed to process up to 512 volume cells at one time. It is obvious that processing this amount of data is not possible in a real-time environment. To rectify this problem, Crane[3] recommends that the subroutines for cell detection and tracking be maintained while the number of cells be reduced by increasing the reflectivity threshold and by incorporating the tangential shear information in the decision process for saving the most important 12 to 16 cells. It would be more consistent with algorithm development to specify a larger peak size, since raising the threshold level would tend to eliminate growing volume cells.

Since it may well be useful to identify elements within storms, such as significant cells, one might consider an algorithm with resolution capabilities between the two algorithms discussed herein. Perhaps if ACDT were modified to track 6 to 10 dBz peaks, or WEATRK were modified to operate with several thresholds, storm structure would be more readily apparent. If the reflectivity peak processing method were to be explored further it would be prudent to write an algorithm in which the peak size would be an input variable. This would enable the researcher to specify a peak size (feature size) that was consistent with the spatial and temporal resolution of the data set. This type of algorithm could be run repeatedly over the same data altering the peak size to first, observe the large scale features of the storm, then to detect and track the feature of interest, and lastly to determine when the algorithm breaks down (that is, no longer can correlate its derived features).

In reviewing our case studies one can see that it might be necessary to either fine tune the ACDT contour region threshold for each case study, or specify a permissible reflectivity range around the threshold. This would eliminate extraneous contour regions, and eliminate insignificant merges and splits of contour regions due to small fluctuations of the reflectivity field.

The Automatic Cell Detection and Tracking algorithm (ACDT) developed by Crane[1, 2, 3, 4] has been evaluated by carefully examining two case studies taken from the 1979 JDOP program. The output products from the ACDT were compared to raw data and to the products from the AFGL storm tracking algorithm WEATRK. We found that the ACDT performs unsatisfactorily when constrained to a 5 to 6 min volume scan repeat time, and when it is required to perform out to a range of 230 km. Therefore, we do not recommend its inclusion in the NEXRAD system at this time.

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12. Gustafson, G.B. (1982) Personal communication.

Appendix A

ACDT Algorithm Output

Table A1. ACDT Volume Scan Output for Volume Scan No. 1, Case Study No. 2

SCAN TIME 1CC 153447 - 154005 VOL SCAN 1 AZ = 39.3 TO 31.9 (DEG)
TRACK REF TIME 153443 - 153447 AZM SCAN 11/5 EL * 0.4 TO 11.8 (DEG)

FIXED CONTOUR OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	AV CELL AZM DEG	AV CELL RNG KM	Z AV DB	Z MX DB	N VOL	N SCL	N CL	SPA X KM	SPA L KM	O R T	WTR FLUX KT/H	AREA XSCN KKM2	VELOCITY AV DEG	VELOCITY CELL M/S	NEAR DIST KM	MX HT KM	ME ID NO	SE ID NO
1	60	146	59	147	32	34	0	0	0	0.0	0.0	0	0.27	0.10	999	999	0.0	2	0	0
2	47	19	48	29	32	32	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	0	0	0
3	292	64	292	65	37	40	6	1	1	4.5	9.4	34	2.05	0.49	999	999	8.2	2	0	0
4	44	126	44	127	34	34	1	0	0	0.0	0.0	0	0.28	0.09	999	999	0.0	1	0	0
5	51	97	51	100	35	39	3	1	1	0.2	4.5	61	0.19	0.04	999	999	0.0	2	0	0
6	40	93	41	92	37	37	1	0	0	0.0	0.0	0	0.12	0.03	999	999	0.0	1	0	0
7	244	227	243	227	37	37	1	0	0	0.0	0.0	0	0.17	0.04	999	999	0.0	4	0	0
8	42	122	42	123	32	32	1	0	0	0.0	0.0	0	0.15	0.05	999	999	0.0	1	0	0
9	40	182	42	182	31	31	1	0	0	0.0	0.0	0	0.04	0.02	999	999	0.0	3	0	0
10	55	121	55	121	30	43	6	1	1	6.7	3.7	316	0.54	0.32	999	999	7.6	5	0	0
11	69	129	69	128	33	33	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	1	0	0
12	71	222	71	222	31	31	1	0	0	0.0	0.0	0	0.05	0.02	999	999	0.0	4	0	0
13	72	214	72	214	31	31	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	4	0	0
14	[illegible]	14	153	15	34	34	1	0	0	0.0	0.0	0	0.16	0.03	999	999	0.0	0	0	0
15	233	226	234	227	41	44	1	0	0	0.0	0.0	0	1.10	0.17	999	999	0.0	7	0	0
16	236	199	235	194	32	44	4	0	0	2.8	7.5	65	2.22	0.53	999	999	0.0	6	0	0
17	249	201	249	201	33	33	1	0	0	0.0	0.0	0	0.17	0.06	999	999	0.0	4	0	0
18	245	48	245	48	33	33	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
19	324	62	322	61	40	51	25	3	3	7.9	[illegible]	48	0.20	0.54	999	999	4.5	7	0	0
20	252	153	253	152	31	31	1	0	0	0.0	0.0	0	0.08	0.03	999	999	0.0	2	0	0
21	256	124	257	123	34	37	2	1	1	0.0	0.0	0	0.31	0.10	999	999	0.0	3	0	0
22	252	143	253	142	32	32	1	0	0	0.0	0.0	0	0.41	0.11	999	999	0.0	2	0	0
23	269	108	268	105	36	41	2	1	0	1.9	10.6	15	1.30	0.33	999	999	0.0	6	0	0
24	292	75	291	74	32	32	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
25	309	24	316	25	36	40	1	0	0	0.0	0.0	0	0.10	0.02	999	999	0.0	1	0	0
26	314	37	322	37	39	47	13	3	3	3.6	7.0	[illegible]	0.99	0.16	999	999	3.6	8	0	0
27	306	53	306	52	32	32	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
28	305	28	305	29	33	33	1	0	0	0.0	0.0	0	0.04	0.01	999	999	0.0	1	0	0
29	316	61	313	58	35	35	2	1	1	0.0	0.0	0	0.07	0.02	999	999	0.0	5	0	0
30	312	54	311	54	32	34	2	1	1	0.0	0.0	0	0.06	0.02	999	999	0.0	1	0	0
31	319	91	319	91	34	34	1	0	0	0.0	0.0	0	0.06	0.02	999	999	0.0	1	0	0
32	357	51	357	52	34	35	2	1	1	0.0	0.0	0	0.06	0.02	999	999	0.0	0	0	0
33	0	51	359	54	32	32	1	0	0	0.0	0.0	0	0.00	0.00	999	999	0.0	3	0	0
34	347	83	341	78	39	47	15	1	1	12.9	13.2	53	4.27	0.69	999	999	6.5	6	0	0
35	17	58	18	58	31	31	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
36	11	43	13	44	44	45	1	0	0	0.0	0.0	0	0.18	0.03	999	999	0.0	0	0	0
37	20	45	20	44	33	33	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
38	5	67	8	68	40	45	16	3	3	5.6	8.4	320	2.68	0.29	999	999	4.7	7	0	0
39	26	96	26	95	38	38	1	0	0	0.0	0.0	0	0.13	0.04	999	999	0.0	1	0	0

Table A1. ACDT Volume Scan Output for Volume Scan No. 1, Case Study No. 2 (Cont'd)

VOLUME CELL DATA

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	Z AV DB	Z PK DB	Z LW DB	Z HI DB	HGT L KM	HGT M KM	HGT H KM	MEAN DIR/S DEG	CELL M/S	SPATIAL SPEC KM	SPATIAL A KM2	(TAN) (SHR) (M/SK)	DOP SPC M/SK	RAD VEL M/S	RAD SPD M/S	CS TR NO	CN TR NO	D O P	R E F	R E J
1	41	92	37	37	37	37	1	1	1	11.8	2.1	0.00	9.2	1.3	0.0	-4.7	0.1	0	6	1	1	1
2	42	132	31	31	31	31	2	2	2	11.8	2.1	0.00	15.3	0.0	0.0	0.0	0.0	0	9	0	1	1
3	42	123	32	32	32	32	1	1	1	11.8	2.1	0.00	21.3	0.0	0.0	0.7	0.0	0	8	0	1	1
4	44	137	34	34	34	34	1	1	1	11.8	2.1	0.00	26.7	0.0	0.0	-3.9	0.0	0	4	0	1	1
5	47	131	34	34	34	34	2	2	2	11.8	2.1	0.00	15.5	0.0	0.0	0.3	0.0	0	10	0	1	1
6	48	22	32	32	32	32	0	2	2	11.8	2.1	0.00	2.1	0.0	0.0	2.2	0.0	0	2	0	1	1
7	50	95	38	38	38	38	1	1	1	11.8	2.1	0.00	4.0	1.1	0.0	-4.0	0.1	0	5	1	1	1
8	51	113	36	36	36	36	1	1	1	11.8	2.1	0.00	9.1	0.0	0.0	-3.7	0.0	0	10	0	1	1
9	52	122	40	42	42	38	1	2	3	11.8	2.1	0.00	4.6	0.0	0.0	1.9	0.6	0	10	0	2	1
10	56	109	38	38	38	38	1	1	1	11.8	2.1	0.00	6.5	1.4	0.0	-8.6	0.1	0	10	1	1	1
11	56	123	39	42	42	36	1	2	3	11.8	2.1	0.00	6.9	0.0	0.0	2.4	0.0	0	10	0	2	1
12	58	142	34	34	34	34	2	2	2	11.8	2.1	0.00	13.3	0.0	0.0	2.0	0.0	0	1	0	1	1
13	59	121	42	43	43	42	1	2	3	11.8	2.1	0.00	5.4	1.1	0.0	3.9	0.9	1	10	1	2	1
14	60	125	37	38	38	36	1	3	5	11.8	2.1	0.00	5.9	0.0	0.0	1.3	1.2	1	10	0	2	1
15	61	128	36	36	36	36	1	1	1	11.8	2.1	0.00	6.1	0.0	0.0	1.3	0.0	1	10	0	1	1
16	61	151	31	31	31	31	2	2	2	11.8	2.1	0.00	33.2	0.0	0.0	-0.4	0.0	0	1	0	1	1
17	69	128	33	33	33	33	1	1	1	11.8	2.1	0.00	6.7	0.0	0.0	3.2	0.0	0	11	0	1	1
18	71	222	31	31	31	31	4	4	4	11.8	2.1	0.00	13.5	0.0	0.0	-1.2	0.0	0	12	0	1	1
19	72	214	31	31	31	31	4	4	4	11.8	2.1	0.00	13.4	0.0	0.0	-0.6	0.0	0	13	0	1	1
20	153	15	34	34	34	34	0	0	0	11.8	2.1	0.00	1.5	1.1	0.0	13.9	0.0	0	14	0	1	1
21	234	227	41	44	44	38	4	5	7	11.8	2.1	0.00	7.7	0.0	0.0	-2.1	2.0	0	15	0	2	1
22	235	192	36	36	36	36	3	3	3	11.8	2.1	0.00	33.3	0.0	0.0	-1.2	0.0	0	16	0	1	1
23	236	205	42	44	44	40	4	4	6	11.8	2.1	0.00	22.6	0.0	0.0	-0.2	0.3	0	16	0	2	1
24	236	194	38	38	38	38	3	3	3	11.8	2.1	0.00	6.9	0.0	0.0	-2.4	0.0	0	16	0	1	1
25	243	227	37	37	37	37	4	4	4	11.8	2.1	0.00	5.7	0.0	0.0	-1.4	0.0	0	7	0	1	1
26	245	48	33	33	33	33	0	0	0	11.8	2.1	0.00	3.2	1.0	0.0	1.8	0.0	0	12	0	1	1
27	249	201	33	33	33	33	4	4	4	11.8	2.1	0.00	22.9	0.0	0.0	0.0	0.0	0	17	0	1	1
28	253	152	31	31	31	31	2	2	2	11.8	2.1	0.00	21.2	0.0	0.0	0.6	0.0	0	20	0	1	1
29	253	162	37	37	37	37	2	2	2	11.8	2.1	0.00	11.5	0.0	0.0	0.5	0.0	0	22	0	1	1
30	256	126	32	34	34	31	1	2	3	11.8	2.1	0.00	7.0	0.0	0.0	-3.2	3.2	2	21	0	2	1
31	257	120	35	37	37	34	1	2	2	11.8	2.1	0.00	6.6	0.0	0.0	-5.4	2.1	2	21	0	2	1
32*	263	109	39	41	39	36	1	2	4	11.8	2.1	0.00	9.9	1.8	0.0	-0.3	3.4	0	23	3	3	1
33	276	102	36	36	36	36	1	1	1	11.8	2.1	0.00	10.7	0.0	0.0	-0.3	0.0	0	23	0	1	1
34	282	92	34	34	34	34	1	1	1	11.8	2.1	0.00	7.0	0.0	0.0	-1.5	0.0	0	3	0	1	1
35	286	66	33	33	33	33	0	0	0	11.8	2.1	0.00	2.1	1.5	0.0	-7.7	0.0	3	19	0	1	1
36	286	80	38	38	38	38	0	0	0	11.8	2.1	0.00	14.5	0.0	0.0	-3.2	0.0	0	3	0	1	1
37	290	64	33	36	36	32	0	1	4	11.8	2.1	1.98	3.7	1.1	0.0	-4.4	2.2	3	19	0	4	1
38	291	74	32	32	32	32	0	0	0	11.8	2.1	0.00	3.0	1.3	0.0	-8.7	0.0	0	24	0	1	1
39	293	82	36	37	37	35	1	1	1	11.8	2.1	0.00	7.5	1.2	0.0	-3.9	0.7	4	3	1	2	1
40	294	87	40	42	42	37	1	1	2	11.8	2.1	0.00	6.6	1.2	0.0	-3.2	1.9	4	3	1	2	1
41	294	91	36	36	36	36	1	1	1	11.8	2.1	0.00	1.7	0.0	0.0	-0.3	0.0	4	3	0	1	1
42	301	62	37	38	38	34	0	1	2	11.8	2.1	0.00	4.0	1.3	0.0	-9.3	1.5	5	19	1	3	1
43	302	64	39	39	39	39	0	0	0	11.8	2.1	0.00	2.7	1.1	0.0	-8.9	1.3	5	19	1	1	1
44	302	86	39	39	39	39	1	1	1	11.8	2.1	0.00	6.3	0.0	0.0	-1.6	0.0	0	3	0	1	1
45	305	98	33	33	33	33	1	1	1	11.8	2.1	0.00	2.0	0.0	0.0	-0.1	0.0	0	28	0	1	1
46	306	52	32	32	32	32	0	0	0	11.8	2.1	0.00	3.2	4.5	0.0	10.2	0.0	6	27	0	1	1
47	307	66	36	38	38	32	0	1	4	11.8	2.1	5.05	6.8	1.7	0.0	-7.9	2.8	0	19	2	4	1
48	311	31	40	40	40	40	0	0	0	11.8	2.1	0.00	6.3	7.6	0.0	8.3	2.2	0	26	2	1	1
49	313	39	39	40	40	39	0	0	0	11.8	2.1	0.00	2.7	4.0	0.0	10.7	1.2	7	26	2	2	1
50	311	56	32	32	32	32	0	0	0	11.8	2.1	0.00	4.0	4.2	0.0	3.3	0.0	6	30	0	1	1

Table A1. ACDT Volume Scan Output for Volume Scan No. 1, Case Study No. 2 (Cont'd)

51	312	52	33	34	34	32	0	0	1	11.8	2.1	0.00	4.7	5.5	0.0	9.0	0.8	6	30	1	2	1
52	316	25	36	40	40	34	0	0	1	11.8	2.1	0.00	2.1	1.4	0.0	6.8	1.3	0	25	0	3	1
53	316	74	38	40	40	34	0	2	6	11.8	2.1	3.08	6.1	1.9	0.0	-4.6	3.2	8	19	1	5	1
54*	317	42	40	41	40	40	0	0	1	11.8	2.1	0.00	3.8	2.7	0.0	10.1	3.3	7	26	3	3	1
55	318	61	34	35	35	33	0	0	1	11.8	2.1	0.00	5.1	3.9	0.0	8.5	2.1	9	29	0	2	1
56	319	67	35	37	37	34	0	1	1	11.8	2.1	0.00	4.7	1.6	0.0	-1.8	10.9	10	19	0	2	1
57	318	91	34	34	34	34	1	1	1	11.8	2.1	0.00	6.1	0.0	0.0	-2.5	0.0	0	31	0	1	1
58	321	80	33	33	33	33	0	0	0	11.8	2.1	0.00	6.9	3.0	0.0	-1.6	3.9	8	34	5	1	1
59	322	74	35	35	35	35	0	0	0	11.8	2.1	0.00	2.2	1.2	0.0	-8.0	0.9	0	19	1	1	1
60	323	84	33	35	35	32	1	2	5	11.8	2.1	0.00	3.3	1.3	0.0	2.3	4.1	8	34	1	3	1
61	327	88	37	37	37	37	1	1	1	11.8	2.1	0.00	1.7	0.0	0.0	-1.8	0.0	0	34	0	1	1
62	328	82	33	33	33	33	1	1	1	11.8	2.1	0.00	3.1	1.4	0.0	-4.7	0.4	0	34	2	1	1
63	329	71	42	43	43	43	0	0	0	11.8	2.1	0.00	4.9	1.3	0.0	-11.2	1.6	0	19	1	1	1
64	331	69	44	44	44	44	0	0	0	11.8	2.1	0.00	7.7	1.6	0.0	-12.4	1.5	11	19	1	1	1
65*	334	65	45	45	44	37	0	1	4	11.8	2.1	0.00	6.3	3.3	0.0	-0.5	8.0	11	19	4	3	1
66*	336	53	50	51	50	49	0	2	4	11.8	2.1	2.83	2.1	2.7	0.0	8.2	2.6	12	19	4	5	1
67	339	86	41	44	44	33	1	1	3	11.8	2.1	0.00	5.2	1.6	0.0	-7.3	4.9	0	34	4	2	1
68	341	95	39	40	40	39	1	1	2	11.8	2.1	0.00	9.4	1.4	0.0	-6.0	0.4	0	34	2	2	1
69	355	51	34	34	34	34	0	0	0	11.5	2.1	0.00	3.0	2.3	0.0	-2.7	8.2	13	32	1	1	1
70	357	82	46	47	47	46	0	1	1	11.8	2.1	0.00	4.7	3.2	0.0	-2.0	8.3	14	34	4	2	1
71	359	77	42	43	43	43	0	0	0	11.8	2.1	0.00	2.9	2.5	0.0	10.8	0.0	15	34	0	1	1
72	359	73	35	35	35	35	0	0	0	11.8	2.1	0.00	2.1	3.4	0.0	-5.1	0.0	15	34	0	1	1
73	359	50	35	35	35	35	0	0	0	11.8	2.1	0.00	1.9	0.0	0.0	-11.4	0.0	13	32	0	1	1
74	359	67	37	37	37	37	0	0	0	11.8	2.1	0.00	3.2	2.8	0.0	-10.6	1.1	16	34	1	1	1
75	0	59	34	36	36	34	0	1	3	11.8	2.1	0.00	3.3	1.2	0.0	-3.4	5.2	16	34	0	3	1
76	359	54	32	32	32	32	0	2	3	11.8	2.1	0.00	2.0	0.0	0.0	-3.6	4.6	13	33	0	3	1
77	1	61	39	39	39	39	0	0	0	11.8	2.1	0.00	4.5	0.0	0.0	-12.1	0.0	16	38	0	1	1
78	1	76	45	45	45	45	0	0	0	11.8	2.1	0.00	6.4	5.4	0.0	3.0	5.9	15	38	2	1	1
79*	3	68	40	45	45	33	0	1	4	11.8	2.1	0.00	4.5	2.5	0.0	-2.3	4.1	16	38	2	3	1
80	8	67	44	45	45	43	0	1	1	11.8	2.1	0.00	5.7	4.4	0.0	-2.4	3.1	16	38	3	2	1
81*	12	57	42	45	42	39	0	1	4	11.8	2.1	1.90	4.0	1.6	0.0	-6.7	5.6	17	38	2	4	1
82	11	52	40	40	40	40	0	0	0	11.8	2.1	0.00	4.1	1.5	0.0	-9.4	0.4	17	38	1	1	1
83	13	44	44	45	43	45	0	0	0	11.8	2.1	0.00	2.8	1.4	0.0	-1.3	6.7	0	36	1	2	1
84	18	58	31	31	31	31	0	0	0	11.8	2.1	0.00	2.1	3.1	0.0	-2.0	4.7	0	35	2	1	1
85	20	44	33	33	33	33	0	0	0	11.8	2.1	0.00	1.8	2.4	0.0	-10.6	0.0	0	37	0	1	1
86	26	95	38	38	38	38	1	1	1	11.8	2.1	0.00	3.3	0.0	0.0	-5.3	0.0	0	39	0	1	1
87	51	101	33	34	33	34	1	1	2	11.8	2.1	0.00	2.1	1.1	0.0	-2.0	2.0	18	5	1	1	1
88*	339	56	41	46	34	40	0	4	7	11.8	2.1	4.13	3.4	2.3	0.0	5.4	3.5	12	19	6	4	1
89	344	50	38	40	35	40	0	0	1	11.8	2.1	0.00	2.6	2.8	0.0	5.4	0.7	0	19	2	1	1
91	350	80	34	34	34	34	0	0	0	11.8	2.1	0.00	3.0	2.4	0.0	-10.8	0.0	0	34	1	0	1
93	39	81	31	31	31	31	1	1	1	11.8	2.1	0.00	7.6	3.3	0.0	1.3	0.2	0	0	1	1	1
94	40	97	32	32	32	32	2	2	2	11.8	2.1	0.00	8.1	1.7	0.0	5.2	0.2	0	0	1	1	1
95	129	12	33	33	33	33	0	0	0	11.8	2.1	0.00	4.7	1.0	0.0	-14.8	0.0	19	0	0	1	1
96	126	17	36	37	36	36	0	1	1	11.8	2.1	4.13	2.4	2.4	0.0	1.6	8.9	19	0	1	4	1
97	228	34	31	31	31	31	0	0	0	11.8	2.1	0.00	1.7	1.8	0.0	-4.8	0.0	0	0	0	1	1
98	234	185	33	33	33	33	5	5	5	11.8	2.1	0.00	30.8	0.0	0.0	0.0	0.0	0	16	0	1	1
99	294	61	34	34	34	34	1	1	1	11.8	2.1	0.00	3.0	0.0	0.0	-6.3	0.0	3	19	0	1	1
100	301	80	32	32	32	32	1	1	1	11.8	2.1	0.00	4.0	0.0	0.0	-6.4	0.0	0	0	0	1	1
101	305	61	36	36	36	36	1	1	1	11.8	2.1	0.00	1.9	4.3	0.0	-8.2	3.1	5	19	1	1	1
102	312	68	39	39	39	39	1	1	1	11.8	2.1	0.00	4.0	2.4	0.0	-7.3	4.3	0	19	2	1	1
103	329	17	35	39	31	39	0	1	2	11.8	2.1	0.00	1.8	1.1	0.0	9.6	1.4	0	0	0	3	1
104	321	64	32	35	32	32	1	3	5	11.8	2.1	1.57	2.7	2.0	0.0	6.8	2.7	10	19	0	4	1
105*	323	36	44	47	33	47	0	2	2	11.8	2.1	0.00	1.9	1.8	0.0	9.8	2.9	20	26	1	3	1
106	326	40	34	34	34	34	0	0	0	11.8	2.1	0.00	1.9	1.4	0.0	9.7	2.1	20	26	2	1	1

Table A1. ACDT Volume Scan Output for Volume Scan No. 1, Case Study No. 2 (Cont'd)

107	330	63	36	39	39	31	2	2	4	11.8	2.1	0.00	7.8	1.4	0.0	-4.9	3.1	0	34	2	2	1
108	333	75	35	32	35	31	1	2	4	11.8	2.1	0.00	4.3	1.1	0.0	-1.7	7.9	0	19	0	3	1
109	344	85	31	31	31	31	1	1	1	11.8	2.1	0.00	7.5	1.6	0.0	-0.6	0.1	0	0	1	1	1
110	350	89	32	42	40	33	2	2	3	11.8	2.1	0.00	3.5	2.0	0.0	4.9	1.5	0	34	1	2	1
111	352	57	32	32'	32	32	1	1	1	11.8	2.1	0.00	1.7	0.0	0.0	3.9	0.0	0	0	0	1	1
112	2	84	39	42	42	36	1	2	3	11.8	2.1	0.00	4.6	3.2	0.0	1.4	7.0	14	38	3	2	1
113	5	76	36	39	39	33	1	7	7	11.8	2.1	0.00	5.1	3.2	0.0	-0.1	4.6	0	38	4	2	1
114	9	71	40	40	40	38	1	1	2	11.8	2.1	0.00	5.5	3.7	0.0	-2.0	4.4	16	38	3	2	1
115	12	62	40	40	40	40	1	1	1	11.8	2.1	0.00	6.0	2.8	0.0	-5.0	5.2	17	38	4	1	1
116	52	106	32	32	32	32	2	2	2	11.8	2.1	0.00	2.0	2.0	0.0	0.0	0.0	18	5	0	1	1
120	55	116	33	33	33	33	5	5	5	11.8	2.1	0.00	4.9	0.0	0.0	4.7	0.0	0	0	0	1	1
121	156	36	32	34	31	34	1	4	5	11.8	2.1	0.00	2.5	5.0	0.0	-6.1	3.3	0	0	2	3	1
122	205	104	33	35	35	32	4	2	6	11.8	2.1	0.00	3.4	0.0	0.0	-2.9	1.3	0	23	0	2	1
123	319	56	37	38	38	34	2	3	5	11.8	2.1	0.24	3.4	5.2	0.0	5.5	3.8	9	29	3	4	1
124	321	45	36	33	34	35	1	4	5	11.8	2.1	0.33	2.8	4.7	0.0	6.5	5.4	21	26	2	5	1
125	321	30	42	43	42	43	1	1	1	11.8	2.1	0.00	3.3	1.5	0.0	10.4	1.1	20	26	0	2	1
126*	337	69	41	44	44	34	2	4	7	11.8	2.1	0.00	5.4	1.3	0.0	2.7	0.7	22	19	1	3	1
127*	340	64	43	45	45	43	2	3	[illegible]	11.8	2.1	0.00	2.8	1.4	0.0	1.1	1.8	23	19	2	3	1
128	347	61	31	31	31	31	2	3	3	11.8	2.1	0.00	2.1	1.1	0.0	-0.4	0.9	24	0	1	2	1
129	5	83	31	31	31	31	3	4	5	11.8	2.1	0.00	8.4	0.0	0.0	-1.5	1.0	0	0	0	2	1
130	12	76	35	37	37	33	3	4	6	11.8	2.1	0.00	1.9	1.3	0.0	-4.6	2.1	16	38	0	3	1
131	319	78	33	33	32	38	3	4	6	11.8	2.1	0.00	6.1	4.1	0.0	1.0	4.5	8	34	4	3	1
132	8	74	32	30	38	38	3	3	2	11.8	2.1	0.00	3.0	1.2	0.0	1.3	0.5	16	38	1	1	1
133	334	27	32	33	32	33	1	2	4	11.8	2.1	3.21	2.3	1.1	0.0	7.1	1.4	20	26	0	4	1
134*	328	34	40	43	40	41	2	4	7	11.8	2.1	1.73	2.6	2.2	0.0	8.3	2.7	20	26	2	6	1
135	316	49	34	34	34	34	2	2	7	11.8	2.1	0.00	[illegible]	4.9	0.0	8.6	0.0	21	26	0	1	1
136	328	29	36	36	36	36	1	1	1	11.8	2.1	0.00	1.7	0.0	0.0	10.5	0.0	20	26	0	1	1
137	20	49	37	37	37	37	3	3	2	11.8	2.1	0.00	2.5	1.9	0.0	-1.1	0.4	0	0	1	1	1
138	347	55	33	34	34	32	4	5	5	11.8	2.1	0.00	2.5	1.0	0.0	1.2	0.3	24	19	0	2	1
139	13	69	35	37	37	33	5	6	7	11.8	2.1	0.00	3.2	1.6	0.0	-5.2	0.5	16	38	2	2	1
140	14	67	36	36	36	36	5	5	5	11.8	2.1	0.00	2.6	1.3	0.0	-6.3	0.0	16	38	0	1	1
141	16	61	42	44	44	40	5	5	6	11.8	2.1	0.00	4.1	2.2	0.0	-5.0	2.6	0	38	2	2	1
142	334	68	34	34	34	34	5	5	5	11.8	2.1	0.00	1.9	1.4	0.0	4.7	0.0	22	19	0	1	1
143	341	63	36	36	36	36	5	5	5	11.8	2.1	0.00	1.9	0.0	0.0	0.5	0.0	23	19	0	1	1
144	15	73	33	33	33	33	6	6	6	11.8	2.1	0.00	4.3	1.0	0.0	-5.5	0.0	16	38	0	1	1
145	325	47	34	35	35	33	4	5	6	11.8	2.1	0.00	3.6	1.6	0.0	11.1	0.7	21	26	0	2	1
146	340	51	37	37	37	37	6	6	6	11.8	2.1	0.00	3.0	4.6	0.0	5.7	1.7	0	19	2	1	1
147	344	18	33	37	34	36	2	3	3	11.8	2.1	0.00	1.9	1.4	0.0	5.3	1.0	0	0	0	3	1
148	326	40	39	39	39	39	8	8	8	11.8	2.1	0.00	2.8	3.9	0.0	0.9	0.0	0	26	0	1	1

Table A1. ACDT Volume Scan Output for Volume Scan No. 1, Case Study No. 2 (Contd)

CLUSTER OUTPUT

TRK NO	CENTROID AZM DEG	RNG KM	Z AV DB	PK DB	N V C	SPE X KM	SEE L KM	ORI ANG DEG	CNT ID	VELOCITY AV EM/S	CELL NM/S	SHEAR MSKM	MX HT KM	ME ID NO	SF ID NO	CELL RCT. MSKM	CELL DIV. MSKM	NC RC CS
1	60	125	39	43	3	0.0	3.6	33	10	0.0	0.0	0.7	5	0	0	0.00	0.00	0
2	257	123	34	37	2	0.0	0.0	0	21	0.0	0.0	0.0	3	0	0	0.00	0.00	0
3	290	63	33	36	3	0.3	3.9	47	19	0.0	0.0	0.5	4	0	0	0.00	0.00	0
4	293	97	37	42	3	0.1	3.2	302	3	0.0	0.0	1.0	2	0	0	0.00	0.00	0
5	303	62	37	39	3	1.1	2.5	54	19	0.0	0.0	1.9	2	0	0	0.00	0.00	0
6	310	53	32	34	3	1.6	2.3	37	30	0.0	0.0	4.5	1	0	0	0.00	0.00	0
7	315	40	39	41	2	0.0	0.0	0	26	0.0	0.0	3.3	1	0	0	0.00	0.00	0
8	320	79	36	40	4	0.2	5.2	6	15	0.0	0.0	2.8	6	0	0	0.00	0.00	0
9	318	58	35	39	2	0.0	0.0	0	29	0.0	0.0	4.9	5	0	0	0.00	0.00	0
10	320	66	34	37	2	0.0	0.0	0	19	0.0	0.0	1.9	5	0	0	0.00	0.00	0
11	332	65	43	45	2	0.0	0.0	0	19	0.0	0.0	2.4	4	0	0	0.00	0.00	0
12	333	54	47	51	2	0.0	0.0	0	19	0.0	0.0	2.6	7	0	0	0.00	0.00	0
13	358	51	33	35	3	1.3	1.9	46	32	0.0	0.0	0.8	3	0	0	0.00	0.00	0
14	353	53	44	47	2	0.0	0.0	0	34	0.0	0.0	3.2	3	0	0	0.00	0.00	0
15	0	75	42	45	3	1.3	1.7	36	36	0.0	0.0	4.2	0	0	0	0.00	0.00	0
16	8	63	38	45	11	3.4	7.4	55	35	0.0	0.0	2.7	7	0	0	0.00	0.00	0
17	12	57	40	45	3	0.4	4.1	19	35	0.0	0.0	1.9	4	0	0	0.00	0.00	0
18	52	103	32	34	2	0.0	0.0	0	5	0.0	0.0	0.6	2	0	0	0.00	0.00	0
19	127	15	34	37	2	0.0	0.0	0	0	0.0	0.0	2.0	1	0	0	0.00	0.00	0
20	326	33	40	47	6	1.9	4.9	314	26	0.0	0.0	1.6	7	0	0	0.00	0.00	0
21	321	47	34	38	3	1.1	2.6	53	26	0.0	0.0	3.9	6	0	0	0.00	0.00	0
22	335	63	39	44	2	0.0	0.0	0	19	0.0	0.0	1.3	7	0	0	0.00	0.00	0
23	340	64	41	45	2	0.0	0.0	0	19	0.0	0.0	1.2	5	0	0	0.00	0.00	0
24	347	58	32	34	2	0.0	0.0	0	19	0.0	0.0	1.0	5	0	0	0.00	0.00	0

VOL SCAN	HHMM	AREA KKM2	WELLX KMT/H	NEAR CELL	NEIGHBOR CLST	CONT	ACT VCL	NO CS	NO FC	VELOCITY EM/S	NM/S	TRK NO	CLS CTR	CNT CTR	G C	OVER				
1	1534	5.0	27.29	7.0	13.6	0.0	143	25	13	11.8	2.1	148	24	39	0	0	0	0	0	0

Table A2. ACDT Volume Scan Output for Volume Scan No. 2, Case Study No. 2

SCAN TIME 100 154044 - 154723 VOL SCAN 2 AZ - 71.1 TO 70.6 (DEG)
TRACK REF TIME 153930 - 154044 AZM SCAN 10/1 EL - 0.5 TO 6.5 (DEG)

FIXED CONTOUR OUTPUT

	CENTROID		AV CELL		Z		N	N	N	SPR	SPR	O	WTR	AREA	VELOCITY		NEAR	MX	MR	SP
TRK	AZM	RNG	AZM	RNG	AV	PK	V	O	C	X	L	F	FLUX	XSCN	AV	CELL	DIST	HT	ID	ID
NO	DEG	KM	DEG	KM	DB	DB	C	C	I	KM	KM	I	MT/H	KKM2	DEG	M/S	KM	KM	NO	NO
40	100	16	100	15	35	35	2	0	0	0.0	0.0	0	0.05	0.01	217	19	0.0	0	0	0
17	242	194	242	194	31	31	1	0	0	0.0	0.0	0	0.02	0.01	258	19	0.0	4	0	0
41	161	31	159	30	36	38	1	0	0	0.0	0.0	0	0.06	0.01	999	999	0.0	1	0	0
42	147	33	144	32	31	32	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	1	0	0
16	236	194	235	184	39	45	4	1	0	1.3	10.3	69	3.18	0.57	235	16	0.0	7	0	0
43	259	118	260	116	32	33	2	0	0	0.0	0.0	0	0.21	0.07	999	999	0.0	2	0	0
44	240	26	242	24	33	35	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	0	0	0
15	233	2[illegible]	232	219	43	48	2	1	0	0.0	0.0	0	4.57	0.44	249	14	0.0	9	0	0
45	242	226	242	227	37	38	1	0	0	0.0	0.0	0	0.42	0.09	999	999	0.0	6	0	0
46	244	217	244	217	31	31	1	0	0	0.0	0.0	0	0.05	0.04	999	999	0.0	5	0	0
47	252	158	251	159	36	37	1	0	0	0.0	0.0	0	0.40	0.12	999	999	0.0	4	0	0
48	255	146	255	146	32	32	1	0	0	0.0	0.0	0	0.07	0.03	999	999	0.0	2	0	0
49	274	71	276	70	31	32	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	3	0	0
23	269	103	268	102	37	46	5	2	1	2.4	5.9	26	1.[illegible]1	0.37	215	22	6.1	6	0	0
50	271	92	272	92	32	34	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	1	0	0
51	280	75	280	75	31	31	1	0	0	0.0	0.0	0	0.23	0.21	999	999	0.0	1	0	0
52	286	92	286	91	32	32	2	0	0	0.0	0.0	0	0.06	0.02	225	14	0.0	1	0	3
53	280	78	281	77	34	35	1	1	1	0.0	0.0	0	0.03	0.01	999	999	0.0	1	0	0
26	312	26	312	25	38	38	1	1	1	0.0	0.0	0	0.03	0.01	302	17	0.0	0	0	0
3	292	82	299	82	36	41	8	1	1	5.2	7.2	35	1.75	0.43	238	16	6.2	2	24	0
54	303	76	304	76	33	34	1	0	0	0.0	0.0	0	0.02	0.01	262	15	0.0	1	0	0
55	311	99	311	99	34	34	1	0	0	0.0	0.0	0	0.24	0.01	999	999	0.0	1	0	0
56	341	67	343	69	41	52	14	4	4	5.1	7.7	317	1.96	0.26	257	19	4.0	6	19	34
57	328	81	329	81	31	31	1	0	0	0.0	0.0	0	0.02	0.01	252	23	0.0	1	0	34
58	359	32	359	33	34	34	1	0	0	0.0	0.0	0	0.05	0.01	999	999	0.0	0	0	0
59	354	92	348	93	41	45	6	3	2	3.3	11.0	295	2.05	0.27	263	21	6.2	3	0	34
34	321	60	323	60	39	48	31	3	3	9.9	14.4	310	3.48	0.6[illegible]	246	13	4.1	7	19	0
60	333	91	332	92	35	37	1	0	0	0.0	0.0	0	0.12	0.03	999	999	0.0	2	0	0
19	338	53	337	54	36	38	1	0	0	0.0	0.0	0	0.01	0.00	177	6	0.0	5	0	0
61	2	63	2	63	37	37	1	1	1	0.0	0.0	0	0.03	0.02	200	13	0.0	0	0	34
62	33	99	34	95	35	37	2	0	0	0.0	0.0	0	0.28	0.08	999	999	0.0	1	0	0
63	9	74	12	73	39	45	17	2	1	3.9	11.9	330	3.31	0.50	250	14	4.2	6	38	34
64	48	113	49	114	32	34	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	3	0	0
65	51	135	51	134	39	38	1	0	0	0.0	0.0	0	0.27	0.06	999	999	0.0	2	0	0
66	52	122	52	122	31	32	1	1	1	0.0	0.0	0	0.02	0.01	999	999	0.0	7	0	0
67	57	132	57	132	38	42	1	1	0	0.0	0.0	0	0.57	0.09	999	999	0.0	8	0	0
10	59	121	60	121	35	35	1	0	0	0.0	0.0	0	0.07	0.02	327	4	0.0	2	0	0

Table A2. A[illegible] Volume Scan Output for Volume Scan No. 2, Case Study No. 2 (Cont'd)

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	RAD	RAD	CS	CN	C	E	R
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	VEL	DEV	TR	TR	D	E	E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	(KM)	[illegible]	M/S	M/S	NO	NO	P	F	J
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0	10	0	1	2
21*	232	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.[illegible]	1.1	0.0	-1.7	2.7	0	15	2	3	2
[illegible]	236	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	16	0	3	2
24	236	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	[illegible]	0.8	2.7	0	16	1	2	2
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.7	0.0	0	17	0	[illegible]	[illegible]
32*	265	104	[illegible]	[illegible]	[illegible]	[illegible]	1	2	5	[illegible]	[illegible]	[illegible]	7.6	1.6	[illegible]	0.9	4.4	0	23	6	6	[illegible]
[illegible]	285	[illegible]	32	32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.9	0.0	0	53	0	[illegible]	2
35	[illegible]	61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4	0.3	3-19		[illegible]	2	2
[illegible]	[illegible]	76	34	34	34	34	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	[illegible]	-7.3	0.[illegible]	0	[illegible]	1	[illegible]	2
37	291	52	33	32	33	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	1.5	1.2	[illegible]	-8.2	[illegible]	3-19		0	1	2
[illegible]	[illegible]	[illegible]	31	[illegible]	[illegible]	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.1	0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	36	35	[illegible]	34	1	1	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.3	4	[illegible]	[illegible]	2	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	4	3	2	7	2
41	293	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.7	4	3	2	3	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	34	1	5	1
[illegible]	303	[illegible]	34	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	34	3	3	1
44	30[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]
47	31[illegible]	64	36	36	36	36	[illegible]	[illegible]	[illegible]	11.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-5.6	[illegible]	25	34	1	[illegible]	[illegible]
[illegible]	312	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]*	32[illegible]	[illegible]	39	[illegible]	[illegible]	[illegible]	1	1	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	34	3	5	[illegible]
[illegible]	321	52	34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34	1	[illegible]	[illegible]
[illegible]	32[illegible]	[illegible]	34	[illegible]	34	34	[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34	1	[illegible]	[illegible]
[illegible]	324	[illegible]	33	[illegible]	[illegible]	[illegible]	4	[illegible]	7	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	34	1	1	[illegible]
[illegible]	325	71	32	[illegible]	32	32	1	1	1	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.1	0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	329	[illegible]	31	31	31	[illegible]	[illegible]	1	1	15.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	[illegible]	2	2	[illegible]
62	335	[illegible]	34	[illegible]	[illegible]	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6	56	[illegible]	[illegible]	2
63	339	[illegible]	33	39	[illegible]	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0	56	1	0	2
64	33[illegible]	62	31	[illegible]	31	31	4	4	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11-19		0	1	2
65	340	59	40	4[illegible]	4[illegible]	40	0	[illegible]	[illegible]	7.5	-4.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.[illegible]	0	56	1	0	2
66	337	54	36	[illegible]	[illegible]	37	0	[illegible]	[illegible]	4.5	4.[illegible]	[illegible]	[illegible]	1.1	[illegible]	[illegible]	1.7	25	19	2	6	1
71	5	60	38	3[illegible]	38	39	1	1	1	16.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	63	1	0	2
74	2	67	34	27	37	32	1	2	3	12.3	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	1.3	27-34		0	4	1
75	2	63	37	37	37	37	[illegible]	0	0	7.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-7.[illegible]	[illegible]	27	61	0	1	2
[illegible]	12	62	36	36	36	36	1	1	1	12.[illegible]	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-7.[illegible]	[illegible]	16	63	1	0	2
81*	18	60	39	41	34	41	0	2	3	16.[illegible]	[illegible]	.99	[illegible]	1.9	0.0	-0.6	4.8	16	63	4	3	2
82	16	56	44	45	44	45	0	[illegible]	1	14.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-4.[illegible]	6.1	16	63	0	2	2
84	21	59	33	33	33	33	3	3	3	11.2	0.9	0.00	7.[illegible]	1.3	[illegible]	-3.2	0.0	16	63	1	0	2
93	346	57	35	37	37	22	3	3	5	15.0	7.1	0.00	[illegible].7	[illegible]	0.0	3.7	0.3	12	56	0	3	2
95	100	14	35	35	35	35	0	[illegible]	[illegible]	11.6	10.0	0.00	1.7	1.5	0.0	13.8	0.0	0	40	0	1	2
100	304	76	33	34	34	33	1	1	1	13.5	2.1	0.00	1.9	1.5	0.[illegible]	-0.2	1.0	4	54	2	2	2
101	308	60	34	36	36	32	1	2	4	7.9	4.5	0.00	[illegible]	3.4	0.0	-9.3	0.6	25	34	0	3	2
102	313	66	37	40	40	33	1	1	4	7.0	-0.4	3.70	3.6	[illegible]	0.0	-5.6	3.3	25	34	3	6	1
104	327	63	37	38	38	35	0	1	3	13.[illegible]	5.[illegible]	4.[illegible]	[illegible]	[illegible].4	0.0	8.0	[illegible].0	25	34	2	5	1
106	334	38	45	46	45	46	0	0	0	14.3	1.4	0.0[illegible]	2.[illegible]	2.3	0.0	7.9	3.3	20	34	3	2	2
108*	339	74	39	44	44	33	1	1	5	15.5	4.4	2.92	9.3	2.2	0.0	-0.7	7.1	28	56	7	5	1
109	347	80	32	32	32	32	6	6	6	14.2	-4.2	0.00	[illegible]	1.0	0.0	-1.8	0.0	0	0	0	1	2
110	355	89	37	37	37	37	1	1	1	17.1	[illegible].7	0.00	1.7	[illegible]	0.0	-4.7	0.3	0	59	2	0	2
111	355	60	31	31	31	31	3	3	3	[illegible]	6.8	0.00	[illegible]	[illegible]	0.0	1.2	0.0	0	0	0	1	2
112	3	87	37	37	37	37	1	1	1	12.6	5.6	0.00	6.4	9.[illegible]	0.0	-5.1	0.0	0	63	1	0	2
113*	8	80	42	44	44	36	1	1	2	13.3	6.5	0.00	6.7	2.1	0.0	0.0	9.0	0	63	6	3	2

[illegible] Output for [illegible] Scenario No. 2, Case Study No. 2
[illegible]

114	11	74	44	43	47	43	1	1	1	11.3	5.7	0.00	3.4	2.2	0.0	-2.8	7.3	16	63	1	1	2
115*	14	63	41	44	44	36	0	1	4	5.4	1.1	2.36	4.1	2.2	0.0	0.9	6.6	16	63	4	4	1
[illegible]	264	[illegible]	37	37	37	37	2	2	2	[illegible]	-1.2	0.00	3.2	1.4	0.0	3.7	0.9	0	-23	2	0	2
[illegible]	325	53	37	34	35	36	0	[illegible]	1	15.7	3.5	0.00	3.4	1.8	0.0	12.6	2.5	25	34	1	2	2
124*	337	[illegible]	41	47	41	47	1	1	1	[illegible]	14.4	0.00	3.8	1.7	0.0	9.7	3.4	25	34	4	3	2
126*	344	71	37	41	41	37	1	1	2	10.3	4.2	0.00	2.4	2.5	0.0	-1.6	8.3	22	56	3	3	2
127	345	[illegible]	51	[illegible]	51	50	1	1	1	14.0	-1.5	0.00	4.7	2.4	0.0	4.1	4.5	12	56	5	2	2
128	352	21	35	35	35	35	1	1	1	9.3	-3.7	0.00	3.7	1.6	0.0	8.9	0.0	0	0	1	0	2
129	8	84	31	32	32	31	1	2	4	13.3	3.0	0.00	[illegible]	1.7	0.0	-2.4	2.7	0	63	1	1	2
130	14	77	34	34	34	34	1	1	1	5.7	2.6	0.00	[illegible]	5.2	0.0	0.1	0.0	16	63	1	0	2
131*	322	77	40	43	43	36	1	2	5	[illegible]	5.4	3.21	5.5	2.6	0.0	-4.9	5.0	25	34	8	7	1
132	12	79	32	32	32	37	1	3	4	14.6	6.3	0.00	3.2	2.6	0.0	-3.1	2.8	16	63	2	1	2
133	349	64	40	40	40	40	0	0	1	17.0	-0.7	0.00	1.5	1.7	0.0	6.4	4.1	29	-26	0	3	2
134	347	34	37	28	26	28	0	[illegible]	[illegible]	16.3	5.4	0.00	2.8	3.2	0.0	4.6	3.8	20	34	2	2	2
139*	15	72	40	43	31	37	1	3	4	9.4	4.4	2.36	3.4	2.9	0.0	-0.8	5.7	16	63	5	4	1
140	17	65	35	40	40	33	3	4	6	[illegible]	7.5	2.59	[illegible]	2.0	0.0	-2.9	2.2	16	63	3	4	1
141	14	65	34	40	40	35	3	4	6	13.1	4.2	[illegible]	4.0	1.3	0.0	-2.7	1.1	16	63	6	4	1
142	346	62	33	33	33	33	2	2	2	[illegible]	1.2	0.00	1.3	[illegible]	0.0	1.2	4.2	12	56	3	0	2
144	20	76	34	34	34	34	3	3	3	17.3	1.4	0.00	1.3	2.0	0.0	-4.4	0.0	0	-63	1	0	2
145*	334	44	44	42	41	47	2	2	2	12.3	2.3	0.00	2.7	1.4	0.0	5.0	3.0	22	34	2	3	2
149	100	17	35	35	35	35	0	0	0	11.8	2.1	0.00	3.2	1.9	0.0	14.4	0.0	0	40	0	1	1
150	144	32	31	32	32	31	0	0	1	11.8	2.1	2.42	3.4	1.6	0.0	-2.3	8.7	0	42	0	4	1
151	159	30	36	33	33	34	0	0	1	11.8	2.1	0.00	2.4	2.8	0.0	-5.1	4.9	0	41	1	3	1
152	236	127	35	35	35	35	3	3	3	11.8	2.1	0.00	34.7	[illegible]	[illegible]	-1.0	0.0	0	16	0	1	1
153	242	24	33	35	35	31	0	0	0	11.8	2.1	2.66	2.2	1.5	0.0	-0.7	9.3	0	44	0	4	1
154	242	227	37	33	38	37	5	6	6	11.8	2.1	0.00	12.2	0.0	0.0	-1.8	0.3	0	45	0	2	1
155	244	217	31	31	31	31	5	5	5	11.8	2.1	0.00	32.2	0.0	0.0	-0.7	0.0	0	46	0	1	1
156	251	159	36	37	37	35	3	3	4	11.8	2.1	0.00	8.0	0.0	0.0	0.3	0.1	0	47	0	2	1
157	255	146	32	32	32	30	2	2	2	11.8	2.1	0.00	15.0	0.0	0.0	-0.3	0.0	0	48	0	1	1
158	259	113	32	33	33	32	2	2	2	11.8	2.1	0.00	15.1	0.0	0.0	-4.2	0.7	0	43	0	2	1
159	261	114	32	33	32	33	2	2	2	11.8	2.1	0.00	10.1	0.0	0.0	1.3	0.2	0	43	0	2	1
160	272	92	32	34	34	31	1	1	1	11.8	2.1	0.00	2.9	0.0	0.0	0.8	1.1	30	50	0	2	1
161	273	95	34	36	72	34	1	2	3	11.8	2.1	0.00	3.2	0.0	0.0	1.0	1.2	30	23	0	3	1
162	272	99	32	33	37	31	1	1	2	11.8	2.1	0.00	11.7	0.0	0.0	0.7	0.4	30	23	0	2	1
163	276	70	31	32	31	31	1	1	3	11.8	2.1	0.00	4.5	1.2	0.0	1.5	3.3	0	19	0	3	1
164	281	77	34	35	34	35	1	1	1	11.8	2.1	0.00	3.9	0.0	0.0	-1.2	0.5	31	53	0	2	1
165	280	75	31	31	31	31	1	1	1	11.8	2.1	0.00	10.9	0.0	0.0	-1.8	0.0	31	51	0	1	1
166	286	92	32	32	32	32	1	1	1	11.8	2.1	0.00	9.2	0.0	0.0	-0.9	0.0	0	52	0	1	1
167	290	85	32	32	32	32	1	1	1	11.8	2.1	0.00	13.5	0.0	0.0	-0.1	0.0	0	3	0	1	1
168	307	89	35	35	35	35	1	1	1	11.8	2.1	0.00	7.2	0.0	0.0	1.2	0.0	0	3	0	1	1
169	311	91	34	34	34	34	1	1	1	11.8	2.1	0.00	4.9	0.0	0.0	0.9	0.0	0	55	0	1	1
170	315	60	31	32	32	31	0	1	1	11.8	2.1	0.00	5.8	2.0	0.0	5.5	2.0	25	34	1	2	1
171	332	92	35	37	37	34	1	1	2	11.8	2.1	0.00	2.4	0.0	0.0	0.3	0.7	0	60	0	2	1
172	340	97	33	35	34	32	1	2	3	11.8	2.1	0.00	5.5	1.6	0.0	-2.3	2.0	32	59	2	3	1
173	343	90	34	34	34	34	1	1	1	11.8	2.1	0.00	1.9	0.0	0.0	0.9	0.0	0	59	0	1	1
174	340	100	38	40	35	39	1	2	3	11.8	2.1	0.00	4.6	1.9	0.0	-2.9	2.1	32	59	3	3	1
175*	350	93	40	44	44	35	1	1	3	11.8	2.1	0.00	7.1	1.5	0.0	-3.0	3.9	0	59	2	3	1
176*	358	91	46	48	48	43	1	1	2	11.8	2.1	0.00	4.6	2.6	0.0	3.3	5.4	33	59	6	3	1
177*	0	91	41	45	45	33	1	2	5	11.8	2.1	2.55	2.9	2.1	0.0	-1.7	7.9	33	63	3	4	1
178	32	100	37	37	37	37	1	1	1	11.8	2.1	0.00	7.4	1.6	0.0	-3.6	0.7	0	62	1	1	1
179	37	91	32	32	32	32	1	1	1	11.8	2.1	0.00	2.5	0.0	0.0	2.5	0.0	0	62	0	1	1
180	49	114	32	34	31	34	2	3	3	11.8	2.1	0.00	4.1	0.0	0.0	3.2	0.5	0	64	0	2	1
181	51	134	38	38	38	38	2	2	2	11.8	2.1	0.00	9.3	1.4	0.0	-1.6	1.8	0	65	1	1	1
182	52	122	31	32	31	32	2	5	7	11.8	2.1	0.56	6.4	0.0	0.0	1.4	1.2	34	66	0	4	1
183*	57	132	38	42	42	33	2	3	8	11.8	2.1	1.53	8.5	1.1	0.0	2.7	2.1	0	67	2	6	1
184	302	80	36	36	36	36	1	1	1	11.8	2.1	0.00	4.0	1.2	0.0	-1.9	0.1	4	3	2	1	4

Table A2. ACDT Volume Scan Output for Volume Scan No. 2, Case Study No. 2 (Cont'd)

185	359	6[illegible]	34	34	34	34	0	0	0	11.8	2.1	0.00	[illegible]	[illegible]	0.0	-5.[illegible]	0.0	2[illegible]	58	0	1	1
187	234	171	33	33	33	33	4	4	4	11.8	2.1	0.00	2.4	0.0	0.0	0.2	0.0	0	16	0	1	1
188	254	131	31	31	31	31	[illegible]	[illegible]	[illegible]	11.8	2.1	0.00	[illegible]	[illegible]	0.0	0.0	0.0	0	0	0	1	1
189	202	34	33	34	33	34	[illegible]	1	1	11.8	2.1	0.00	1.5	1.7	0.0	2.6	4.7	0	0	0	2	1
190	261	10[illegible]	33	33	3[illegible]	29	[illegible]	[illegible]	[illegible]	11.8	2.1	0.00	0.0	0.0	0.0	1.5	0.0	0	23	0	1	1
191	225	88	32	32	32	32	1	1	1	11.8	2.1	0.00	3.3	[illegible]	0.0	1.6	0.0	0	0	0	1	1
192	279	95	34	34	34	34	2	2	2	11.8	2.1	0.00	1.[illegible]	[illegible]	0.0	1.2	0.0	0	0	0	1	1
193	347	1[illegible]3	32	32	32	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	[illegible]	[illegible]	0.0	1.1	0.0	0	0	0	1	1
194	317	65	35	3[illegible]	3[illegible]	34	1	1	1	11.8	2.1	0.00	3.5	1.3	0.0	-1.9	6.8	25	34	2	3	1
195	327	56	37	29	31	35	1	1	1	11.8	2.1	0.00	2.1	1.1	0.0	5.4	3.4	25	34	[illegible]	[illegible]	1
197	36	36	33	33	33	33	[illegible]	[illegible]	[illegible]	11.8	2.1	0.00	[illegible]	[illegible]	0.0	3.8	0.7	0	0	0	1	1
198	51	132	32	32	32	32	4	4	4	11.8	2.1	0.00	3.2	[illegible]	[illegible]	2.2	0.0	0	0	0	1	1
199	232	2[illegible]	31	31	31	31	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	[illegible]	[illegible]	0.0	0.5	0.0	0	0	0	1	1
[illegible]	23[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	[illegible]	[illegible]	0.0	[illegible]	[illegible]	0	15	0	1	1
[illegible]	27[illegible]	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	4.[illegible]	[illegible]	[illegible]	1.[illegible]	1.3	0	23	0	[illegible]	1
202	222	27	34	34	34	34	[illegible]	4	[illegible]	11.8	2.1	0.00	4.7	1.7	[illegible]	4.2	[illegible]	35	34	1	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	3.3	1.2	0.0	7.9	0.7	25	34	0	4	1
204	232	22	26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	0.00	4.7	1.3	0.0	[illegible]	1.1	25	34	2	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	7.[illegible]	1.[illegible]	[illegible]	5.4	1.1	2[illegible]	34	4	[illegible]	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.8	[illegible]	2[illegible]	56	2	3	1
[illegible]	34[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	2.5	1.[illegible]	[illegible]	1.8	1.7	22	56	2	4	1
[illegible]	3[illegible]2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	5	11.8	2.1	0.00	2.4	[illegible]	[illegible]	3.[illegible]	3.4	22	56	3	5	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	1.[illegible]	1.2	0.0	-0.9	0.7	0	0	1	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	1.[illegible]	1.1	[illegible]	-3.7	[illegible]	[illegible]	[illegible]	[illegible]	2	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	3[illegible]	34	4	3	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.8	2.1	[illegible]	[illegible]	[illegible]	0.0	4.1	1.[illegible]	25	3[illegible]	0	4	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	4	4	11.8	2.1	[illegible]	[illegible]	1.[illegible]	[illegible]	-1.[illegible]	0.4	0	0	0	2	1
[illegible]	242	[illegible]	2[illegible]	32	3[illegible]	32	2	4	4	11.8	2.1	0.00	1.6	[illegible]	[illegible]	1.2	1.3	22	56	0	3	1
[illegible]	323	6[illegible]	33	33	33	33	7	3	3	11.8	2.1	0.00	2.0	2.6	0.0	-7.2	0.2	25	34	1	1	1
21[illegible]	17	26	32	4[illegible]	4[illegible]	27	4	4	[illegible]	11.8	2.1	0.00	2.5	1.2	0.0	-2.5	1.2	16	63	2	2	1
217	359	25	41	42	42	42	1	1	1	11.8	2.1	0.00	1.[illegible]	[illegible]	0.0	0.9	0.0	29	0	0	1	1
218	279	6[illegible]	31	31	31	31	4	4	4	11.8	2.1	0.00	[illegible]	1.2	0.0	3.5	0.0	0	0	0	1	1
219*	339	47	44	46	46	44	3	[illegible]	4	11.8	2.1	0.00	1.4	1.5	0.0	3.5	1.2	25	34	3	3	1
220	342	44	46	46	46	46	2	[illegible]	3	11.8	2.1	0.00	1.7	1.2	0.0	4.6	1.1	25	34	2	2	1
221	345	40	41	42	40	42	2	3	3	11.8	2.1	0.00	2.9	1.5	0.0	0.9	1.8	0	34	2	2	1
222	150	26	31	31	31	31	1	1	1	11.8	2.1	0.00	1.6	2.9	0.0	11.4	0.0	0	0	0	1	1
223	195	25	31	31	31	31	1	1	1	11.8	2.1	0.00	1.8	0.0	0.0	-3.1	0.0	0	0	0	1	1
224	345	67	45	47	47	42	5	5	6	11.8	2.1	0.00	2.2	1.5	0.0	3.3	0.9	22	56	2	2	1
225	338	50	47	48	48	46	3	4	4	11.8	2.1	0.00	1.8	1.1	0.0	3.3	0.0	25	34	0	2	1
226	136	30	35	35	35	35	2	2	2	11.8	2.1	0.00	1.9	2.1	0.0	8.9	0.0	0	0	0	1	1
227	342	59	31	31	31	31	5	5	5	11.8	2.1	0.00	2.4	1.1	0.0	6.2	0.0	12	56	0	1	1

Table A2. ACDT Volume Scan Output for Volume Scan No. 2, Case Study No. 2 (Cont'd)

CLUSTER OUTPUT

CENTROID			Z		N	SPD	DIR	OPT	VIL	VELOCITY		SHEAR	MX	MR	SF	CELL	CELL	NO
TRK NO	AZM DEG	RNG KM	AV DB	PK DB	V	KM	KM	ANG	ID	AV EM/S	CELL MM/S	MSKM	HT KM	ID NO	ID NO	PCT. MSKM	DIV. MSKM	REC CS
3	290	59	32	33	2	0.0	0.0	0	0	15.7	0.0	0.7	4	0	0	0.00	0.00	0
4	301	82	36	41	6	3.1	4.6	30	3	15.5	9.0	1.3	2	0	0	-0.42	4.02	5
25	322	61	39	48	25	9.6	10.6	47	34	9.7	6.3	1.5	7	8	12	0.93	3.43	14
26	312	35	38	38	1	0.0	0.0	0	56	14.1	-9.7	1.0	0	0	0	0.00	0.00	0
8	332	80	32	34	2	0.0	0.0	0	56	24.2	4.9	2.4	1	0	0	0.00	0.00	0
11	334	65	31	31	1	0.0	0.0	0	0	3.7	4.3	0.0	4	0	0	0.00	0.00	0
27	1	64	35	37	3	1.0	2.4	30	61	5.7	6.6	1.3	3	0	16	0.00	0.00	2
16	15	69	39	45	12	5.3	6.2	313	62	13.0	3.7	2.2	6	17	0	0.66	4.51	11
12	345	60	45	52	4	1.6	2.1	40	56	16.7	2.3	2.4	5	23	0	-2.47	4.93	3
20	336	38	43	47	3	1.1	4.6	314	34	19.0	3.6	2.2	1	21	0	-3.96	4.44	3
28	340	77	38	44	2	0.0	0.0	0	56	17.3	5.9	2.2	5	0	0	0.00	0.00	0
22	346	72	40	47	5	6.4	3.5	323	36	19.3	14.0	1.6	6	0	0	0.00	0.00	1
29	353	24	41	42	2	0.0	0.0	0	0	20.4	-2.6	0.7	1	0	20	0.00	0.00	0
30	272	95	33	36	3	0.8	2.9	291	23	0.0	0.0	0.0	3	0	0	0.00	0.00	0
31	231	76	33	35	2	0.0	0.0	0	52	0.0	0.0	0.0	1	0	0	0.00	0.00	0
32	340	93	36	42	2	0.0	0.0	0	59	0.0	0.0	1.8	3	0	0	0.00	0.00	0
33	359	91	44	48	3	0.0	0.0	0	59	0.0	0.0	2.5	5	0	0	0.00	0.00	0
34	52	122	31	32	1	0.0	0.0	0	66	0.0	0.0	0.0	7	0	0	0.00	0.00	0
35	326	88	33	35	2	0.0	0.0	0	34	0.0	0.0	1.6	5	0	0	0.00	0.00	0

VOL SCAN	HHMM	AREA KKM2	WFLUX KMT/H	NEAR CELL	NEIGHBOR CLST	CONT	ACT VOL	NO CS	NO FC	VELOCITY EM/S	MM/S	TRK NO	CLS CTR	CNT CTR	C C	OVER
2	1539	4.5	27.56	3.9	16.0	0.0	142	25	12	13.5	3.9	229	35	67	0	0 0 0 0 0

Table A3. ACDT Volume Scan Output for Volume Scan No. 3, Case Study No. 2

SCAN TIME 100 154708 - 155150 VOL SCAN 3 AZ - 27.9 TO 18.5 (DEG)
TRACK REF TIME 154523 - 154708 AZM SCAN 9/0 EL - 0.9 TO 6.5 (DEG)

FIXED CONTOUR OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	AV CELL AZM DEG	AV CELL RNG KM	Z AV DB	Z PK DB	N V C	N S C	N C L	SPR X KM	SPR L KM	O R I	WTE FLUX MT/H	AREA XSCN KKM2	VELOCITY AV DEG	VELOCITY CELL M/S	NEAR DIST KM	MX HT KM	MR IC NC	SE IC NC
62	31	109	32	106	37	40	2	0	0	0.0	0.0	0	0.44	0.10	257	16	0.0	2	0	0
63	31	77	31	79	31	32	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	5	0	0
69	37	56	37	56	33	33	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
70	42	58	44	61	34	37	1	0	0	0.0	0.0	0	0.04	0.01	999	999	0.0	5	0	0
71	50	130	50	131	33	35	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	6	0	0
67	56	141	57	140	39	44	2	0	0	0.0	0.0	0	0.72	0.11	258	16	0.0	4	0	0
72	56	130	57	130	32	33	1	0	0	0.0	0.0	0	0.06	0.02	999	999	0.0	3	0	0
73	126	28	120	29	37	40	1	0	0	0.0	0.0	0	0.09	0.02	999	999	0.0	2	0	0
74	135	23	135	23	32	32	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
15	233	215	233	215	41	45	3	1	1	2.2	5.2	77	4.18	0.50	232	12	0.0	7	0	0
75	241	221	240	223	37	37	1	0	0	0.0	0.0	0	0.52	0.13	999	999	0.0	5	0	0
76	252	149	252	149	39	42	1	0	0	0.0	0.0	0	0.70	0.11	999	999	0.0	4	0	0
16	236	183	236	186	42	47	5	1	1	1.3	7.3	56	5.61	0.64	241	6	4.7	6	0	0
77	258	123	257	120	34	35	1	0	0	0.0	0.0	0	0.12	0.04	999	999	0.0	3	0	0
78	258	54	261	53	32	33	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	3	0	0
43	259	110	260	109	35	37	1	1	1	0.0	0.0	0	0.09	0.02	277	13	0.0	2	0	0
79	264	75	264	74	32	32	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	1	0	0
80	268	16	268	16	31	31	1	0	0	0.0	0.0	0	0.00	0.00	999	999	0.0	0	0	0
81	285	69	236	67	35	38	1	1	1	0.0	0.0	0	0.18	0.05	999	999	0.0	3	0	0
82	270	53	270	82	33	35	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	4	0	0
53	280	78	282	78	31	32	1	0	0	0.0	0.0	0	0.01	0.00	189	5	0.0	4	0	0
23	270	97	272	97	36	44	4	1	1	3.2	8.7	23	0.88	0.19	226	15	0.0	5	0	0
83	282	65	284	64	33	34	1	0	0	0.0	0.0	0	0.03	0.01	220	15	0.0	4	0	0
84	296	73	296	72	32	33	1	0	0	0.0	0.0	0	0.13	0.04	215	13	0.0	1	0	3
85	296	67	296	67	31	31	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
86	298	61	300	60	33	36	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	3	0	0
3	306	82	306	80	35	37	3	2	2	4.5	4.9	42	0.47	0.14	254	16	0.0	2	0	0
87	331	34	331	34	32	32	1	0	0	0.0	0.0	0	0.01	0.00	999	999	0.0	0	0	0
88	340	104	341	104	36	38	1	0	0	0.0	0.0	0	0.09	0.02	999	999	0.0	2	0	0
89	343	87	344	84	31	32	2	1	1	0.0	0.0	0	0.02	0.01	218	10	0.0	4	0	0
90	358	101	358	101	38	41	3	1	1	0.5	4.1	81	0.31	0.05	999	999	0.0	2	0	0
34	339	63	337	64	39	48	33	5	5	9.0	16.4	53	4.79	0.83	253	13	4.0	7	56	0
91	5	35	6	39	41	46	5	1	1	1.3	5.7	336	0.27	0.03	999	999	5.1	5	0	0
63	16	78	17	79	39	45	8	2	2	4.5	5.9	321	1.47	0.24	235	14	5.1	8	0	0

Table A3. ACDT Volume Scan Output for Volume Scan No. 3, Cast Study No. 2 (Cont'd)

VOLUME CELL OUTPUT

ITEM NO	CENTROID AZM DEG	RNG KM	AV DB	PK DB	LW	HI	L	N	H	ERR/Z	KM/Z	SPACIAL SPED KM	A KM2	(TAN) (SER) (MSK)	COR SEC MSK	RAD VEL M/S	RAD SPD M/S	CS TR NO	CN TR NO	C G P	P E F	R E J
230	130	109	42	42	40	40	1	1	1	13.5	3.2	0.00	7.5	0.0	0.0	-5.3	0.0	0	62	0	1	1
231	31	[illegible]	31	32	31	32	1	[illegible]	5	13.[illegible]	[illegible]	3.11	4.[illegible]	1.1	0.0	0.4	2.1	0	68	0	4	1
232	37	[illegible]	33	37	33	33	[illegible]	[illegible]	[illegible]	13.[illegible]	[illegible]	0.00	2.5	1.1	0.0	4.2	0.0	0	69	0	1	1
233	44	61	34	37	34	37	[illegible]	3	5	13.5	3.5	3.70	[illegible]	1.3	0.0	3.1	1.6	0	70	1	6	1
234	52	121	33	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13.5	3.9	0.00	5.5	[illegible]	0.0	1.5	0.7	0	71	0	3	1
235	56	141	41	44	44	[illegible]	[illegible]	3	4	13.5	3.9	0.00	9.2	1.1	0.0	3.7	1.9	0	67	1	2	1
236	57	121	32	32	33	32	6	6	2	13.2	3.9	0.02	3.1	[illegible]	0.0	0.3	1.2	0	72	0	2	1
237	100	[illegible]	37	40	37	31	0	1	0	13.0	3.9	0.00	2.3	1.3	0.0	-2.5	6.2	0	73	1	3	1
238	135	22	32	32	31	32	[illegible]	[illegible]	[illegible]	13.[illegible]	3.9	0.00	2.6	[illegible]	0.0	-11.1	0.0	0	74	0	1	1
239	236	[illegible]	41	41	41	41	3	3	3	13.5	3.9	0.00	7.6	1.2	0.0	-3.0	2.3	36	16	1	1	1
240	240	222	27	27	27	27	5	5	5	13.5	3.9	0.00	12.3	[illegible]	0.0	0.0	0.0	0	75	0	1	1
241	252	143	39	40	40	34	0	3	4	13.5	3.9	0.00	13.9	1.1	0.0	1.7	0.7	0	76	1	2	1
242	257	[illegible]	34	25	32	35	[illegible]	[illegible]	[illegible]	13.5	3.9	0.00	[illegible]	[illegible]	0.0	-4.0	4.0	0	77	0	2	1
243	261	[illegible]	33	33	31	32	[illegible]	1	0	13.5	3.9	2.46	2.1	1.4	0.0	4.1	3.1	0	78	0	4	1
244	264	74	32	32	32	32	1	1	1	13.5	3.9	[illegible]	[illegible]	1.3	0.0	6.0	2.5	0	79	1	2	1
245	[illegible]	[illegible]	33	35	30	33	1	0	4	13.5	3.9	0.40	6.7	1.2	0.0	2.1	2.1	0	82	0	4	1
246	283	16	31	31	31	31	0	[illegible]	[illegible]	13.5	3.9	0.00	1.5	1.5	0.0	-11.1	0.0	0	80	0	1	1
247	296	67	35	35	35	33	1	1	3	13.5	3.9	0.00	3.6	1.0	0.0	-0.1	2.7	37	91	0	3	1
248	292	67	31	31	31	31	0	[illegible]	[illegible]	13.5	3.9	0.00	[illegible]	[illegible]	0.0	0.0	0.0	0	85	0	1	1
[illegible]	233	216	43	45	45	42	5	[illegible]	7	13.7	6.7	0.00	26.4	0.0	0.0	1.0	0.1	38	15	0	2	2
[illegible]	[illegible]	[illegible]	33	[illegible]	[illegible]	32	0	1	3	13.5	3.9	[illegible]	[illegible]	2.3	0.0	-6.3	1.4	39	86	1	3	1
[illegible]	[illegible]	19	47	47	47	47	4	4	4	11.5	[illegible]	0.00	17.2	0.0	0.0	1.6	0.0	0	16	0	1	2
[illegible]	230	[illegible]	42	44	44	42	4	[illegible]	2	[illegible]	3.2	0.00	[illegible]	1.1	0.0	3.1	3.1	0	16	1	1	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.5	4.6	0.0	-0.3	6.1	0	34	2	4	1
251	201	34	32	22	26	[illegible]	[illegible]	[illegible]	[illegible]	13.[illegible]	3.9	0.00	3.1	1.3	0.0	0.0	0.0	0	87	0	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4	0.0	-3.9	0.3	0	88	2	2	1
253	[illegible]	[illegible]	31	32	31	32	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	0.0	-0.1	3.3	28	89	1	4	1
254	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.9	1.1	0.0	-4.4	0.0	0	90	0	1	1
255	[illegible]	[illegible]	[illegible]	41	41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.6	0.0	-5.5	4.7	40	90	2	2	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	-1.0	5.2	41	23	3	4	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	0.0	3.1	3.5	42	93	0	3	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	0.0	-4.6	1.3	0	84	1	1	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	-5.0	1.1	4	3	2	1	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-7.2	0.1	39	34	0	5	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	1.5	[illegible]	[illegible]	[illegible]	0	91	0	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	33	15	0	2	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.3	[illegible]	0	16	0	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0	1	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	39	34	3	4	1
263	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42	90	0	1	1
264	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.4	25	34	3	4	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	43	34	1	1	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	43	34	3	4	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22	34	1	2	1
63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	1.5	[illegible]	[illegible]	[illegible]	25	34	4	4	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.9	25	34	3	2	2
65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.3	[illegible]	4.4	[illegible]	0	34	1	0	2
[illegible]	[illegible]	[illegible]	44	[illegible]	[illegible]	[illegible]	1	[illegible]	4	13.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.0	1.8	12	34	3	3	1
267	54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	13.5	3.9	0.00	[illegible]	[illegible]	0.0	1.0	[illegible]	0	0	0	1	1
269	356	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	2.4	[illegible]	[illegible]	[illegible]	0.3	[illegible]	0	0	2	1

Table A3. ACDT Volume Scan Output for Volume Scan No. 3, Case Study No. 2 (Cont'd)

270	14	[illegible]	32	33	32	32	4	4	5	13.0	3.9	0.00	[illegible]	[illegible]	0.0	-1.0	1.0	0	0	0	0	1
271	352	72	35	34	33	33	3	3	4	17.5	3.9	0.00	4.0	1.6	0.0	-2.9	0.0	32	34	3	3	1
272	19	57	36	36	36	33	3	4	6	10.5	7.4	1.00	4.1	1.6	0.0	-0.7	1.6	16	0	2	4	1
273	354	50	45	45	40	44	2	2	0	17.5	3.3	0.00	2.3	1.6	0.0	2.6	1.0	12	34	0	2	1
274*	10	39	41	42	40	41	1	0	2	10.0	3.3	0.00	1.0	1.0	0.0	0.7	0.0	42	91	1	3	1
275	324	74	33	35	30	33	3	4	4	[illegible]	[illegible]	0.00	2.3	3.0	0.0	1.3	3.9	39	34	1	2	1
80	17	72	34	34	34	34	4	4	4	13.3	7.0	0.00	3.0	1.0	0.0	-0.7	0.0	16	-63	0	1	0
276	269	93	32	30	32	32	5	3	3	13.0	7.3	0.00	7.1	1.0	0.0	-0.3	0.0	0	0	0	1	1
277	1	47	73	33	33	37	3	4	5	[illegible]	7.4	0.00	4.3	1.0	0.0	-0.2	1.7	0	91	1	0	[illegible]
278	21	22	27	27	27	27	2	2	5	[illegible]	7.3	0.00	0.0	1.0	0.0	-6.5	0.1	16	0	1	1	1
279	41	63	39	39	39	39	5	5	5	13.0	3.5	0.00	0.1	0.0	0.0	-2.5	0.0	0	0	0	1	1
[illegible]	351	34	33	33	35	39	7	[illegible]	[illegible]	[illegible]	[illegible]	0.00	1.4	[illegible]	0.0	-3.1	0.0	12	34	1	0	2
260	265	52	32	32	32	32	3	4	4	13.0	3.3	0.00	4.0	0.4	0.0	6.1	1.7	0	0	0	2	1
82	[illegible]	47	34	33	36	31	3	4	5	1.0	7.4	0.00	7.0	1.4	0.0	-5.2	1.1	0	0	0	0	[illegible]
[illegible]	325	76	31	31	31	31	6	6	6	13.0	7.3	0.00	1.6	5.0	0.0	0.0	0.0	0	0	[illegible]	1	1
[illegible]	[illegible]	42	41	42	36	41	3	3	4	13.0	3.4	0.00	1.0	1.1	0.0	-1.3	1.4	42	51	0	3	1
[illegible]	319	40	31	31	31	31	3	3	3	13.0	[illegible]	0.00	1.6	3.6	0.0	-7.4	0.0	0	0	0	1	1
[illegible]	340	43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	4.0	0.0	0	0	0	1	1
[illegible]	346	60	32	[illegible]	30	30	6	6	2	13.0	[illegible]	0.00	2.5	[illegible]	0.0	4.0	[illegible]	0	0	0	1	1
[illegible]	310	61	31	32	32	33	1	2	2	5.0	4.5	0.00	3.0	4.0	0.0	-0.5	4.3	39	34	0	2	2
102	315	63	40	40	40	40	1	1	1	3.0	-1.4	0.00	2.0	0.3	0.0	-9.9	1.3	39	34	1	1	2
[illegible]	350	79	37	39	32	33	1	6	7	12.3	-1.3	0.00	2.7	1.5	0.0	0.5	4.1	22	34	6	3	2
115	17	68	42	43	42	43	1	1	1	11.0	7.0	0.00	1.9	3.7	0.0	-11.7	0.0	16	63	1	0	2
[illegible]	266	98	34	35	35	36	2	3	5	[illegible]	3.6	0.00	[illegible]	1.4	0.0	1.9	1.7	0	23	2	2	2
120*	350	72	45	46	46	44	1	1	3	17.4	9.4	0.00	2.7	1.5	0.0	2.0	7.5	22	34	2	3	2
122*	349	55	43	45	43	45	3	5	2	14.2	-4.3	0.00	1.8	2.0	0.0	2.6	2.9	12	34	2	3	2
128	353	57	36	36	36	36	4	4	4	6.5	-2.9	0.00	2.3	1.7	0.0	-2.3	0.0	12	34	1	0	2
129	12	89	38	38	38	38	1	1	1	14.1	5.3	0.00	2.5	2.4	0.0	-3.2	4.9	0	63	4	0	2
130	15	79	38	38	36	37	1	1	1	7.4	3.3	0.00	3.3	3.1	0.0	-7.7	0.0	44	63	1	0	2
131*	327	81	40	41	40	41	1	2	3	12.4	12.2	0.00	5.7	3.1	0.0	-3.6	5.9	43	34	9	3	2
132	16	83	40	40	40	40	1	1	1	15.4	6.6	0.00	10.0	3.9	0.0	-4.7	5.0	44	63	1	1	2
[illegible]	16	76	37	37	37	37	1	1	1	7.6	2.4	0.00	2.9	3.3	0.0	-8.0	0.0	0	63	1	0	2
140*	20	73	42	45	37	37	1	3	3	11.2	6.5	1.54	3.6	1.7	0.0	-2.0	1.7	16	63	5	3	2
152	236	176	33	33	33	33	5	5	5	5.7	3.1	0.00	12.1	[illegible]	0.0	0.2	0.0	36	16	0	1	2
159	260	109	35	37	37	37	1	2	2	[illegible]	-0.1	0.00	4.0	1.1	0.0	3.7	2.1	45	43	1	2	2
164	232	72	31	32	31	31	1	2	4	3.2	4.2	4.10	2.3	0.0	0.0	0.3	0.4	0	53	0	4	1
165	232	72	33	34	34	32	1	2	3	9.9	2.9	0.00	3.4	0.0	0.0	2.2	0.3	0	0	0	2	2
168	311	35	35	27	31	32	1	1	2	15.1	3.2	0.00	4.4	2.2	0.0	-3.1	2.8	0	3	1	2	2
178	35	104	33	34	34	33	1	2	2	13.9	2.9	0.00	10.2	1.3	0.0	-1.7	4.4	0	62	2	2	2
183	58	136	34	37	37	31	2	2	3	14.2	2.2	0.00	4.6	1.5	0.0	0.8	3.0	0	67	1	1	2
184	303	75	34	34	34	34	1	1	1	13.3	-1.2	0.00	3.3	1.3	0.0	-9.0	0.2	46	3	1	1	2
192	280	94	32	32	32	32	1	1	1	6.1	2.5	0.00	10.6	0.0	0.0	1.0	0.0	0	23	0	1	2
194	319	66	34	35	35	35	2	3	4	10.0	-0.3	0.00	4.3	4.5	0.0	7.7	2.3	39	34	2	3	2
199	232	209	40	40	40	40	5	5	5	7.4	4.5	0.00	9.4	0.0	0.0	1.0	0.0	0	15	0	1	2
201	273	102	36	36	36	36	1	1	1	9.3	9.0	0.00	4.9	0.0	0.0	2.9	0.0	41	23	0	1	2
202	329	87	32	32	32	32	2	2	2	11.5	1.4	0.00	1.2	2.7	0.0	2.3	0.2	35	-34	2	0	2
203	335	75	34	37	37	32	1	1	3	12.4	11.3	0.00	6.0	1.4	0.0	6.3	2.8	25	34	3	3	2
204	336	62	37	37	37	37	0	0	0	12.3	5.1	0.00	3.5	4.1	0.0	11.7	0.0	0	34	1	0	2
205*	342	60	41	43	43	41	0	2	3	15.7	10.8	0.00	3.1	1.3	0.0	6.0	4.1	12	34	2	3	2
206	344	82	31	31	31	31	4	4	4	8.6	5.8	0.00	2.3	0.0	0.0	3.0	0.0	28	89	0	1	2

Table A3. ACDT Volume Scan Output for Volume Scan No. 3, Case Study No. 2 (Contd)

207	342	80	33	33	33	33	1	1	1	10.0	6.0	0.00	3.2	1.2	0.0	-6.6	0.0	22	34	1	1	2
208	352	71	40	40	40	40	1	1	1	12.1	3.4	0.00	1.8	4.0	0.0	-8.2	5.3	22	34	2	0	2
209	26	71	36	36	36	36	3	3	3	10.3	6.4	0.00	1.6	0.0	0.0	-2.6	0.0	0	0	0	1	2
*211	329	84	36	40	34	33	2	4	6	13.5	2.6	1.42	6.1	2.2	0.0	3.3	5.1	35	-34	3	3	2
213	16	86	35	35	35	35	3	4	4	8.3	6.4	0.00	4.2	1.4	0.0	-1.9	0.8	44	63	4	2	2
214	353	72	36	36	36	36	1	1	1	16.7	-1.0	0.00	5.2	1.5	0.0	4.8	0.0	22	34	1	0	2
215	308	65	31	32	31	32	1	2	2	14.9	4.3	0.00	4.6	1.7	0.0	-7.3	0.7	39	34	1	2	2
216	22	81	37	38	37	33	1	3	4	16.7	4.7	0.00	4.1	1.8	0.0	-3.9	3.3	16	63	5	3	2
218	284	64	33	34	34	31	0	2	4	10.6	7.9	2.62	4.1	1.0	0.0	2.1	1.4	37	83	0	5	1
219*	350	51	46	42	45	46	0	2	4	16.3	10.2	3.90	3.4	1.3	0.0	0.5	1.4	12	34	6	5	1
224	347	66	38	40	40	35	0	2	5	8.5	0.3	4.32	3.9	1.4	0.0	4.7	3.4	22	34	6	6	1
227*	346	59	41	44	44	39	2	3	5	10.0	4.2	3.72	3.2	1.2	0.0	1.9	1.1	12	34	1	4	1

CLUSTER OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	Z AV DB	Z PK DB	N V C	SPR X KM	SPR L KM	ORT ANG DEG	CNT ID	VELOCITY AV KM/S	VELOCITY CELL NM/S	SHEAR MSKM	MX HT KM	MR ID NO	SP ID NO	CELL RCT. MSKM	CELL DIV. MSKM	NC RC CS
36	236	179	38	41	2	0.0	0.0	0	16	1.5	3.7	1.0	5	0	0	0.00	0.00	0
37	285	65	34	33	2	0.0	0.0	0	81	9.8	11.7	1.0	4	0	0	0.00	0.00	0
38	233	219	42	45	2	0.0	0.0	0	15	14.4	8.6	0.0	7	0	0	0.00	0.00	0
39	314	64	35	40	8	1.7	10.1	19	34	7.7	2.7	2.8	4	0	25	-2.01	3.67	6
28	344	84	31	32	2	0.0	0.0	0	99	6.4	8.2	0.6	4	0	0	0.00	0.00	0
40	359	102	39	41	2	0.0	0.0	0	90	0.0	0.0	1.7	2	0	0	0.00	0.00	0
41	271	99	38	44	2	0.0	0.0	0	23	13.4	13.7	0.9	5	0	0	0.00	0.00	0
42	7	39	43	46	3	1.9	1.9	44	91	0.0	0.0	1.1	4	0	0	0.00	0.00	0
4	303	82	37	37	1	0.0	0.0	0	3	13.1	13.0	1.2	1	0	0	0.00	0.00	0
25	338	69	36	41	4	1.9	4.4	309	34	14.1	9.3	1.9	4	11	0	-0.86	4.53	3
43	329	74	37	41	3	1.1	5.3	318	34	16.4	5.1	2.9	3	0	25	-0.24	4.49	3
22	351	72	39	46	8	3.1	4.3	322	34	14.1	3.0	1.8	7	0	0	-1.13	4.58	6
12	349	55	43	48	8	2.1	4.7	308	34	13.7	3.6	1.4	6	25	0	-1.12	4.15	6
16	19	76	39	45	6	1.2	5.9	39	63	15.2	7.6	2.3	8	0	0	1.04	4.51	4
44	16	83	38	40	3	0.0	2.7	30	63	9.5	6.9	3.2	4	0	16	3.17	4.88	3
45	260	109	35	37	1	0.0	0.0	0	43	13.4	-1.5	1.1	2	0	0	0.00	0.00	0
46	303	75	34	34	1	0.0	0.0	0	3	14.3	-3.5	1.3	1	0	4	0.00	0.00	0
35	329	86	35	40	2	0.0	0.0	0	0	12.9	1.9	2.3	6	0	0	0.00	0.00	0

VOL SCAN	HHMM	AREA KKM2	WFLUX KMT/H	NEAR NEIGHBOR CELL	NEIGHBOR CLST	NEIGHBOR CENT	ACT VCL	NC CS	NC FC	VELOCITY KM/S	VELOCITY NM/S	TRK NC	CLS CTR	CNT CTR	G C	OVER				
3	1545	3.5	21.83	6.0	13.6	0.0	113	18	10	12.5	4.6	284	46	91	0	0	0	0	0	0

Table A4. ACDT Volume Scan Output for Volume Scan No. 4, Case Study No. 2

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SCAN TIME 100   155222 - 155746   VOL SCAN   4  AZ - 40.3 TO  39.4 (DEG)
TRACK REF TIME  155115 - 155227   AZM SCAN 970  EL -  0.4 TO   6.5 (DEG)
```

FIXED CONTOUR OUTPUT

	CENTROID		AV CELL		DZ		N	N	N	CPR	CPR	C	MIS	AREA	VELOCITY		NEAR	MX	MS	CP
TRK NO	AZM DEG	RNG KM	AZM DEG	RNG KM	AV DB	MX DB	V C	S C	C L	KM	KM	T	FLUX MT/H	XSCN KKM2	AV CELL DEG	M/S	DIST KM	HT KM	ID NO	ID NO
92	57	119	56	11?	34	36	1	0	0	.0	0.0	[illegible]	0.01	0.00	999	999	0.0	4	0	0
67	55	146	56	14?	4?	46	4	1	1	2.?	7.1	222	1.1?	0.??	154	15	0.0	3	0	0
93	47	123	4?	12?	32	32	1	0	0	0.0	0.0	0	0.0?	0.00	999	999	0.0	3	0	0
94	48	135	49	135	32	32	1	0	0	0.0	0.0	0	0.04	0.00	999	999	0.0	2	0	0
95	52	167	53	16?	31	31	1	0	0	0.0	0.0	0	0.07	0.00	999	999	0.0	2	0	0
96	105	29	106	2?	33	33	1	0	0	0.0	0.0	0	0.16	0.03	999	999	0.0	0	0	0
75	241	215	241	214	43	45	?	0	0	0.0	0.0	0	1.93	0.09	244	21	0.0	6	0	0
16	234	193	235	19?	44	4?	4	2	2	1.3	14.7	??	2.30	1.27	219	12	0.0	5	15	0
97	255	144	253	142	41	45	?	1	1	0.0	0.0	0	0.93	0.16	999	999	0.0	6	0	0
98	247	18?	247	18?	32	33	1	0	0	0.0	0.0	0	0.12	0.05	999	999	0.0	3	0	0
99	315	102	316	100	32	32	1	0	0	0.0	0.0	0	0.05	0.02	999	999	0.0	1	0	0
100	250	12	222	[illegible]	31	31	1	0	0	0.0	0.0	0	1.07	0.0?	999	999	0.0	0	0	0
101	261	117	261	116	32	34	1	0	0	0.0	0.0	0	0.04	0.01	999	999	0.0	2	0	0
102	270	49	276	48	34	36	4	2	0	1.7	2.7	34	0.04	0.01	211	20	0.0	5	0	0
103	276	32	277	31	32	33	1	0	0	0.0	0.0	0	0.05	0.02	999	999	0.0	1	0	0
23	274	95	269	96	35	38	6	1	1	2.6	10.?	26	1.40	0.36	336	10	5.8	2	0	0
34	340	69	339	69	39	46	??	5	0	9.0	17.6	53	?.60	0.96	252	13	4.9	7	99	0
104	301	29	301	28	31	31	1	0	0	0.0	0.0	0	0.00	0.00	999	999	0.0	0	0	0
3	300	75	295	72	34	39	13	1	1	5.3	15.4	31	2.07	0.51	235	11	6.7	4	81	0
105	309	52	310	51	31	31	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	0	0	0
106	340	106	341	107	35	35	1	0	0	0.0	0.0	0	0.10	0.03	999	999	0.0	1	0	0
107	338	100	338	100	34	36	2	0	0	0.0	0.0	0	0.11	0.04	999	999	0.0	1	0	0
108	347	111	346	111	32	32	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	1	0	0
109	343	94	343	94	31	31	1	0	0	0.0	0.0	0	0.03	0.01	999	999	0.0	1	0	0
89	348	86	348	96	31	31	1	0	0	0.0	0.0	0	0.03	0.01	250	21	0.0	1	0	0
110	345	92	343	91	31	31	1	0	0	0.0	0.0	0	0.02	0.01	999	999	0.0	1	0	0
90	358	107	358	105	35	41	2	0	0	0.0	0.0	0	0.31	0.06	329	12	0.0	1	0	0
111	28	89	29	88	34	34	1	0	0	0.0	0.0	0	0.07	0.02	999	999	0.0	1	0	0
63	17	84	19	88	40	47	9	4	4	4.4	6.4	321	2.20	0.34	248	14	4.0	6	0	0
112	7	46	6	49	38	42	4	1	1	0.4	6.0	319	0.61	0.10	216	17	0.0	0	91	34
113	1	108	2	107	33	33	1	0	0	0.0	0.0	0	0.17	0.03	217	19	0.0	1	0	90
62	33	115	34	114	33	33	1	0	0	0.0	0.0	0	0.07	0.03	263	25	0.0	1	0	0
114	29	121	29	119	36	36	1	0	0	0.0	0.0	0	0.10	0.03	999	999	0.0	1	0	0
115	38	112	33	112	32	32	1	0	0	0.0	0.0	0	0.05	0.02	999	999	0.0	1	0	0
116	41	68	42	73	36	40	3	0	0	1.3	3.2	310	0.15	0.03	239	25	0.0	5	0	0

Table A4. ACDT Volume Scan Output for Volume Scan No. 4, Case Study No. 2 (Contd)

VOLUME CELL OUTPUT

TRK NO	CENTROID AZM DEG	CENTROID RNG KM	Z AV DB	Z PK DB	Z LW DB	Z HI DB	MCI L	MCI M	MCI H	MEAN KM/S	CELL KM/S	SPATIAL CORR KM	SPATIAL A KM2	(TAN) (SHR) (MSK)	COF SPC MSK	RAD VEL M/S	RAD SPD M/S	CS TR NO	CN TR NO	D P	R E F	R E J
230	34	114	33	33	33	33	1	1	1	20.2	3.4	0.00	4.7	0.0	0.0	-3.9	0.0	0	62	0	1	2
235	55	147	45	46	45	46	2	3	3	11.9	12.0	0.00	5.3	1.3	0.0	1.3	3.9	47	67	3	2	2
238	129	28	35	35	35	35	1	1	1	15.2	-0.9	0.00	1.5	1.2	0.0	5.1	0.0	0	0	0	1	2
239	237	173	41	41	41	41	3	3	3	5.5	8.7	0.00	9.3	1.7	0.0	-0.4	6.0	0	16	3	0	2
240	240	217	45	45	45	45	4	4	4	16.5	7.0	0.00	5.5	0.0	0.0	0.1	0.0	0	75	0	1	2
285	48	126	32	32	32	32	1	2	3	12.5	4.6	0.00	5.9	0.0	0.0	0.0	0.0	0	93	0	2	1
247	291	66	36	38	38	32	0	1	3	10.0	11.8	4.92	9.9	1.2	0.0	-3.4	1.5	37	3	2	4	1
248	300	61	31	32	31	32	2	3	3	13.9	4.5	0.00	5.6	1.3	0.0	-6.9	0.7	48	0	0	3	2
21	233	208	46	46	46	46	4	4	4	17.9	9.5	0.00	16.2	0.0	0.0	0.1	0.0	38	16	0	1	2
23	235	188	44	47	47	38	5	5	9	16.6	5.3	0.00	7.5	0.0	0.0	-0.1	0.5	0	-16	0	2	2
24	237	186	44	44	44	44	3	3	3	4.6	5.5	0.00	26.6	1.6	0.0	3.9	1.5	49	16	1	1	2
250	317	67	35	37	33	35	0	1	3	16.8	2.3	0.00	5.5	2.3	0.0	-5.3	7.1	39	34	3	3	2
266	49	135	32	32	32	32	2	2	2	12.5	4.6	0.00	9.1	0.0	0.0	0.3	0.0	0	94	0	1	1
253	348	86	31	31	31	31	1	1	1	17.2	5.8	0.00	12.6	1.6	0.0	-7.3	0.0	0	89	1	1	2
254	356	104	34	34	34	34	1	1	1	10.7	6.0	0.00	3.3	1.2	0.0	-4.1	0.0	0	90	1	0	2
32	271	94	37	37	37	37	2	2	2	12.5	12.7	0.00	13.3	0.0	0.0	1.1	0.0	0	-23	0	1	2
267	50	118	34	36	31	36	1	3	4	12.5	4.6	0.00	2.3	0.0	0.0	0.1	0.1	0	92	0	2	1
268	53	166	31	31	31	31	2	2	2	12.5	4.6	0.00	14.6	0.0	0.0	-0.3	0.0	0	95	0	1	1
289	60	148	34	34	34	34	2	2	2	12.5	4.6	0.00	16.2	0.0	0.0	1.4	0.0	0	67	0	1	1
290	106	26	33	33	33	33	0	0	0	12.5	4.6	0.00	2.5	1.0	0.0	15.8	0.0	0	96	0	1	1
38	297	65	35	37	37	34	2	3	4	15.9	-2.5	0.00	5.9	1.7	0.0	-4.1	1.1	48	0	3	3	2
291	222	6	31	31	31	31	0	0	0	12.5	4.6	0.00	2.1	1.5	0.0	-0.5	0.0	0	100	0	1	1
40	306	83	39	39	39	39	1	1	1	9.0	13.6	0.00	5.2	0.0	0.0	-0.3	0.0	0	3	0	1	2
292	247	189	38	39	38	38	3	3	3	12.5	4.6	0.00	4.5	0.0	0.0	0.3	0.0	0	98	0	1	1
42	303	61	34	37	37	31	0	0	1	3.9	6.0	0.00	6.7	2.0	0.0	-6.7	4.2	39	34	1	2	2
293	255	143	40	41	41	40	2	2	3	12.5	4.6	0.00	5.6	0.0	0.0	2.1	1.0	50	97	0	2	1
294	2 1	116	32	34	34	31	1	2	2	12.5	4.6	0.00	5.2	0.0	0.0	0.0	0.0	0	101	0	2	1
295	264	106	35	37	37	34	1	1	2	12.5	4.6	0.00	2.9	0.0	0.0	1.3	1.1	51	23	0	2	1
296	262	100	32	32	32	32	1	1	2	12.5	4.6	0.00	7.4	0.0	0.0	0.1	0.1	51	23	0	2	1
259	272	69	34	37	37	32	0	1	3	12.5	4.6	0.00	3.3	1.1	0.0	0.3	2.9	0	3	0	3	1
262	233	61	31	31	31	31	1	1	1	10.9	1.2	0.00	5.2	0.0	0.0	-0.9	0.0	52	0	0	1	2
53	323	68	36	39	39	33	0	1	3	2.7	-2.3	0.00	5.5	1.5	0.0	-6.1	7.6	0	34	2	2	2
263	2	107	33	33	33	33	1	1	1	12.3	10.9	0.00	5.6	1.2	0.0	-10.1	0.0	0	113	1	0	2
297	277	81	32	33	33	31	1	1	1	12.5	4.6	0.00	6.8	1.0	0.0	-0.9	1.6	0	103	0	2	1
298	287	72	34	36	36	32	0	1	1	12.5	4.6	0.00	5.4	0.0	0.0	-3.1	0.4	37	3	0	2	1
59	337	70	36	36	36	36	0	0	0	26.0	2.7	0.00	2.9	9.7	0.0	-4.5	0.0	0	34	1	0	2
299	285	87	33	33	33	33	1	1	1	12.5	4.6	0.00	19.8	0.0	0.0	-0.3	0.0	0	23	0	1	1
265*	354	66	42	45	42	36	3	4	7	13.9	-0.1	2.16	6.1	1.9	0.0	0.7	2.7	12	34	5	5	1
300	288	77	32	33	33	31	0	1	1	12.5	4.6	0.00	4.5	0.0	0.0	-1.7	1.1	37	3	0	2	1
63	341	73	40	40	40	40	0	0	0	9.3	5.6	0.00	13.1	0.0	0.0	-15.0	0.0	0	34	0	1	2
64	344	65	39	39	39	39	0	0	0	15.7	5.9	0.00	1.8	9.3	0.0	8.5	0.0	0	34	1	0	2
301	298	82	34	34	34	34	1	1	1	12.5	4.6	0.00	1.6	0.0	0.0	-1.7	0.0	0	3	0	1	1
268	301	28	31	31	31	31	0	0	0	12.5	4.6	0.00	1.9	9.3	0.0	10.2	0.0	0	104	0	1	1
302	301	74	36	38	38	35	0	1	1	12.5	4.6	0.00	16.2	1.1	0.0	-5.1	1.5	0	3	1	2	1
270	17	95	33	34	33	34	4	5	5	15.4	6.1	0.00	13.5	1.0	0.0	1.7	0.6	53	63	0	2	2
271	358	70	32	32	32	32	5	5	5	17.8	1.2	0.00	2.7	0.0	0.0	-2.5	0.0	12	34	0	1	2

Table A4. ACDT Volume Scan Output for Volume Scan No. 4, Case Study No. 2 (Contd)

303	310	51	31	31	31	31	0	0	0	12.5	4.6	0.00	6.1	7.8	0.0	4.1	0.0	0	105	0	1	1
304	316	56	36	37	35	32	1	1	1	12.5	4.6	0.00	5.5	0.0	0.0	-3.8	0.9	0	3	0	2	1
272	21	62	37	39	34	37	3	4	6	12.0	4.7	0.00	5.0	1.3	0.0	-3.2	1.4	16	63	2	3	2
273	1	54	38	38	36	38	0	0	0	16.3	10.2	0.00	2.7	0.0	0.0	-0.5	0.0	12	112	0	1	2
274	14	43	41	42	42	42	0	0	0	13.0	9.7	0.00	1.7	5.7	0.0	2.4	0.9	42	112	1	1	2
275	325	73	33	37	33	33	0	0	0	[illegible]	1.3	0.00	0.2	1.4	0.0	-10.6	0.0	0	34	1	0	2
305	316	102	32	32	32	32	1	1	1	12.5	4.6	0.00	6.7	1.1	0.0	-3.2	0.3	0	99	1	1	1
306	320	74	36	36	36	36	0	0	0	12.5	4.6	0.00	2.7	1.3	0.0	-9.7	1.3	0	34	1	1	1
307	330	74	40	40	40	40	0	[illegible]	[illegible]	12.5	4.6	0.00	9.1	0.0	0.0	-13.2	0.0	0	34	0	1	1
277	3	51	32	32	32	32	0	0	0	9.4	9.2	0.00	0.9	9.8	0.0	2.0	0.0	0	112	1	0	2
278	24	56	36	36	36	36	4	4	4	15.0	2.4	0.00	0.9	0.0	0.0	-3.0	0.0	54	63	0	1	2
279	43	71	37	40	39	37	6	3	5	13.1	9.2	6.37	3.7	1.6	0.0	-0.9	5.0	0	116	1	5	1
280	271	48	33	34	34	37	0	1	0	11.6	11.2	0.00	7.6	1.3	0.0	1.7	5.0	55	100	0	3	2
281	328	77	4[illegible]	40	40	40	0	0	0	10.4	6.1	0.00	7.3	1.4	0.0	-8.7	2.2	0	34	1	1	2
92	7	47	39	39	39	39	0	0	0	9.5	11.6	0.00	0.0	9.7	0.0	3.1	0.0	42	112	1	0	0
283	348	66	33	37	33	33	0	0	0	10.0	1.7	0.00	0.1	4.1	0.0	-6.6	0.0	0	34	1	0	2
308	336	101	36	36	36	36	1	1	1	12.5	4.6	0.00	1.5	1.1	0.0	-3.1	0.0	0	107	0	1	1
309	340	100	33	33	33	33	1	1	1	12.5	4.6	0.00	6.9	0.0	0.0	-4.9	0.0	0	107	0	1	1
310	341	107	35	35	35	35	1	1	1	12.5	4.6	0.00	4.4	0.0	0.0	-3.6	0.0	0	106	0	1	1
311	343	94	31	31	31	31	1	1	1	12.5	4.6	0.00	11.4	0.0	0.0	-4.2	0.0	0	109	0	1	1
312	346	111	32	32	32	32	1	1	1	12.5	4.6	0.00	7.0	0.0	0.0	-2.6	0.0	0	108	0	1	1
101	314	62	32	32	32	32	2	3	7	9.4	10.7	0.00	3.7	0.0	0.0	-1.6	5.7	39	34	0	2	2
313	348	41	31	31	31	31	1	1	1	12.5	4.6	0.00	9.7	0.0	0.0	-4.7	0.0	0	110	0	1	1
314	359	126	41	41	41	41	1	1	1	12.5	4.6	0.00	4.0	1.4	0.0	-9.5	0.1	0	90	1	1	1
315	29	85	34	34	34	34	1	1	1	12.5	4.6	0.00	7.0	2.2	0.0	1.4	1.4	0	111	1	1	1
316	29	119	36	36	36	36	1	1	1	12.5	4.6	0.00	2.1	0.0	0.0	-0.4	0.0	0	114	0	1	1
317	39	112	32	32	32	32	1	1	1	12.5	4.6	0.00	11.6	1.1	0.0	0.8	0.2	0	115	1	1	1
318	241	212	39	41	41	37	4	4	6	12.5	4.6	0.00	7.5	1.2	0.0	3.6	2.9	0	75	1	1	1
109	353	79	38	38	38	38	3	4	4	10.5	1.1	0.00	1.9	0.0	0.0	0.8	0.3	22	34	0	2	2
320	49	141	32	32	32	32	3	3	3	12.5	4.6	0.00	16.3	0.0	0.0	0.7	0.0	0	0	0	1	1
321	52	150	35	35	35	35	3	3	3	12.5	4.6	0.00	5.7	0.0	0.0	1.8	0.0	0	67	0	1	1
322	122	31	39	41	41	38	0	0	1	12.5	4.6	0.00	2.9	2.2	0.0	1.5	7.9	0	0	0	2	1
323	231	196	37	37	37	37	5	5	5	12.5	4.6	0.00	4.1	0.0	0.0	2.8	0.0	0	0	0	1	1
324	234	157	32	32	32	32	4	4	4	12.5	4.6	0.00	22.7	0.0	0.0	1.0	0.0	0	0	0	1	1
117	235	178	42	43	43	43	4	4	4	12.5	4.6	0.00	11.5	1.0	0.0	1.1	0.0	0	0	0	1	1
118	307	71	33	33	33	33	1	1	1	12.5	4.6	0.00	2.4	1.8	0.0	-10.5	0.0	0	3	0	1	1
119	285	68	34	36	36	32	1	2	4	12.5	4.6	0.00	3.1	0.0	0.0	-0.9	3.7	37	3	0	2	1
325	254	140	42	45	45	32	3	3	6	12.5	4.6	0.00	8.7	1.3	0.0	-0.1	1.3	50	97	1	2	1
326	265	102	33	33	33	33	2	2	2	12.5	4.6	0.00	3.2	0.0	0.0	0.0	0.0	51	23	0	1	1
122	263	98	37	37	37	37	2	2	2	7.8	-5.9	0.00	3.4	0.0	0.0	1.6	0.0	51	23	0	1	2
327	289	71	32	32	32	32	1	1	1	12.5	4.6	0.00	13.3	0.0	0.0	-3.9	0.0	37	3	0	1	1
328	276	47	33	36	34	36	0	2	3	12.5	4.6	6.37	3.3	1.1	0.0	5.6	0.7	55	102	1	5	1
329	39	116	31	31	31	31	4	4	4	12.5	4.6	0.00	3.6	0.0	0.0	-0.1	0.0	0	0	0	1	1
126*	349	71	38	42	38	32	0	3	7	4.5	0.7	2.55	5.8	1.1	0.0	-1.2	4.0	22	34	2	6	1
129	12	93	38	38	38	38	1	1	1	10.0	10.1	0.00	2.0	1.3	0.0	-5.1	0.2	0	63	2	0	2
131*	331	80	37	41	41	31	0	1	4	12.7	8.7	0.00	3.5	1.2	0.0	1.6	5.5	63	34	1	3	2
132	19	85	38	39	39	38	1	3	4	16.1	4.1	0.00	7.1	1.2	0.0	-3.5	2.7	16	63	2	3	2
330	38	73	35	35	35	35	2	2	2	12.5	4.6	0.00	4.5	0.0	0.0	3.2	0.0	0	116	0	1	1
331	54	154	32	32	32	32	8	8	8	12.5	4.6	0.00	6.3	0.0	0.0	2.7	0.0	0	0	0	1	1
332	248	81	32	33	33	32	3	4	4	12.5	4.6	0.00	4.2	1.3	0.0	-3.3	0.3	0	0	1	2	1
334	262	84	32	32	32	32	3	3	3	12.5	4.6	0.00	4.0	3.7	0.0	-7.9	0.0	0	0	1	1	1
335	278	62	33	35	32	35	2	3	4	12.5	4.6	0.00	2.0	1.1	0.0	4.2	0.2	56	0	0	3	1

Table A4. ACDT Volume Scan Output for Volume Scan No. 4, Case Study No. 2 (Cont'd)

139	15	79	47	47	47	47	0	0	0	8.7	6.5	0.00	7.1	0.0	0.0	-9.7	0.0	57	63	0	1	2
336*	317	54	34	35	35	32	2	3	5	12.5	4.5	1.75	2.4	5.7	0.0	1.9	5.1	58	0	3	5	1
337	329	70	32	32	32	32	3	3	3	12.5	4.5	0.00	2.5	2.2	0.0	5.5	0.0	0	0	0	1	1
338	334	72	33	33	33	33	3	4	4	12.5	4.5	0.00	2.4	0.0	0.0	4.8	0.5	43	34	0	2	1
339	344	75	32	32	32	32	3	3	3	12.5	4.6	0.00	2.2	1.3	0.0	1.4	1.5	0	0	2	1	1
340	356	56	36	39	38	33	4	4	6	12.5	4.5	2.95	4.3	1.1	0.0	2.5	3.9	0	34	2	4	1
341*	7	55	40	41	41	40	2	3	4	12.5	4.6	0.00	3.4	1.2	0.0	-1.6	1.1	59	0	5	3	1
342*	14	50	45	46	46	46	2	3	6	12.5	4.5	0.00	6.5	1.2	0.0	-0.2	1.0	0	0	2	3	1
343	19	96	34	34	34	34	4	4	4	12.5	4.6	0.00	1.9	1.3	0.0	-0.3	0.3	53	63	1	1	1
344	29	94	33	33	33	33	4	4	4	12.5	4.6	0.00	4.9	2.2	0.0	1.1	0.0	0	0	0	1	1
345	34	71	32	33	33	32	3	4	4	12.5	4.5	0.00	3.3	0.0	0.0	0.4	1.0	0	0	0	2	1
346*	0	62	45	46	46	45	2	4	6	12.5	4.5	3.01	3.5	1.4	0.0	-4.5	2.0	12	34	5	4	1
152	237	178	40	40	40	40	4	4	4	-4.1	4.5	0.00	5.6	2.3	0.0	-9.5	0.0	0	-16	1	0	2
347	260	56	32	32	32	32	2	2	2	12.5	4.6	0.00	2.6	3.3	0.0	-8.5	0.0	0	0	0	1	1
348	318	25	31	31	31	31	1	1	1	12.5	4.6	0.00	1.7	4.0	0.0	13.5	0.0	0	0	0	1	1
349	335	91	32	32	32	32	5	5	5	12.5	4.6	0.00	10.0	2.0	0.0	2.4	0.0	0	0	0	1	1
350	19	47	42	43	43	43	2	2	2	12.5	4.6	0.00	4.0	2.0	0.0	-1.1	1.5	0	0	1	1	1
351	276	67	33	33	33	33	3	3	4	12.5	4.5	0.00	2.5	1.1	0.0	2.9	0.2	56	0	0	2	1
352	44	74	35	35	35	35	5	5	5	12.5	4.5	0.00	4.3	1.1	0.0	-0.4	0.0	0	116	0	1	1
153	257	104	31	31	31	31	2	2	2	17.2	-3.3	0.00	4.6	1.1	0.0	3.3	0.0	0	0	0	1	2
353	280	46	32	33	32	32	3	4	4	12.5	4.5	0.00	3.9	1.2	0.0	5.4	0.5	60	102	0	3	1
354	356	65	41	42	42	42	4	4	4	12.5	4.6	0.00	1.9	0.0	0.0	1.3	0.0	12	34	0	1	1
355	6	59	37	38	36	36	4	5	7	12.5	4.5	0.00	3.1	1.3	0.0	-1.4	1.0	59	0	2	2	1
356	318	52	31	31	31	31	4	4	4	12.5	4.6	0.00	4.5	4.3	0.0	-8.5	0.0	53	0	1	1	1
165	282	69	32	33	32	33	1	2	3	8.5	1.7	0.00	4.3	1.0	0.0	-0.3	1.5	37	3	0	3	2
357	0	65	39	39	39	39	7	7	7	12.5	4.6	0.00	5.1	2.0	0.0	-0.1	0.3	0	0	1	1	1
358	279	50	38	39	38	38	5	5	5	12.5	4.6	0.00	1.9	1.1	0.0	6.3	0.0	60	108	0	1	1
168	310	50	35	35	35	35	1	1	1	11.5	-5.5	0.00	2.3	2.0	0.0	-7.1	0.0	0	-3	0	1	2
183	56	140	36	36	36	36	2	2	2	3.6	10.5	0.00	5.3	1.7	0.0	-2.9	1.2	0	67	2	0	2
184	304	69	31	31	31	31	0	0	0	14.4	-5.4	0.00	2.1	1.2	0.0	-6.3	0.0	0	3	1	0	2
192	279	91	38	39	38	38	1	1	1	7.7	-1.5	0.00	5.0	0.0	0.0	-0.2	0.0	0	23	0	1	2
199	232	205	45	45	45	45	5	5	5	2.1	7.6	0.00	44.5	2.0	0.0	-1.7	0.0	38	16	0	1	2
203	341	76	40	40	40	40	0	0	0	17.4	11.6	0.00	2.5	1.3	0.0	-13.6	0.1	0	34	1	1	2
206	343	81	32	32	32	32	0	0	0	3.0	2.3	0.00	5.1	1.2	0.0	-7.6	0.2	0	34	1	1	2
207	351	78	35	34	36	32	2	3	6	11.9	0.7	0.96	4.2	1.3	0.0	-4.0	4.9	22	34	2	5	1
211	336	34	34	34	34	34	1	1	1	21.9	7.9	0.00	2.6	1.2	0.0	-9.1	0.0	43	34	1	0	2
213	19	99	38	39	37	39	4	4	5	17.4	5.4	0.00	2.3	1.1	0.0	-1.1	1.2	16	63	1	2	2
215	312	61	33	35	34	31	0	1	3	15.4	2.6	1.66	4.0	1.3	0.0	-7.0	2.1	39	34	1	3	2
216	24	84	39	39	39	39	4	4	4	14.5	4.7	0.00	1.8	1.1	0.0	-3.2	0.2	54	63	1	1	2
219	357	55	46	46	46	46	0	1	0	16.6	10.7	0.00	3.6	1.7	0.0	-0.1	2.7	12	34	1	2	2
224	351	65	39	39	39	39	2	2	2	11.9	-0.1	0.00	1.9	1.4	0.0	-0.3	0.0	61	-34	1	0	2
227	351	60	42	43	43	43	0	0	0	14.3	5.6	0.00	13.9	5.0	0.0	7.9	0.7	61	34	1	1	2

Table A4. ACDT Volume Scan Output for Volume Scan No. 4, Case Study No. 2 (Cont'd)

CLUSTER OUTPUT

	CENTROID		Z		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	VELOCITY		[illegible]	[illegible]	[illegible]	[illegible]	CELL [illegible]	CELL [illegible]	NO [illegible]
TRK	AZM	RNG	AV	PK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NO	DEG	KM	DB	DB	[illegible]	KM	KM	[illegible]		[illegible]	[illegible]			[illegible]	NO	MSEW	MSEW	[illegible]
47	55	147	45	49	1	[illegible]	[illegible]	[illegible]	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37	287	70	33	33	[illegible]	[illegible]	3.[illegible]	314	3	7.[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
48	299	63	33	37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38	232	207	45	46	[illegible]	[illegible]	[illegible]	[illegible]	16	13.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
49	237	186	44	44	1	[illegible]	[illegible]	[illegible]	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
39	313	63	34	37	4	1.1	4.1	[illegible]	34	11.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-2.2[illegible]	5.1[illegible]	4
50	255	142	41	45	[illegible]	[illegible]	[illegible]	[illegible]	97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
51	264	102	34	37	4	1.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
52	293	91	31	31	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	353	62	42	45	[illegible]	2.1	5.2	[illegible]	34	[illegible]	[illegible]	1.4	7	[illegible]	[illegible]	[illegible]	4.61	4
53	18	96	33	34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	20	85	35	39	[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]	14.[illegible]	[illegible]	1.2	[illegible]	44	[illegible]	-1.55	5.93	3
42	10	45	40	42	[illegible]	[illegible]	[illegible]	[illegible]	11[illegible]	[illegible]	[illegible].1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].00	[illegible]
54	24	85	37	39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].1	[illegible]	4	[illegible]	16	[illegible]	[illegible].00	C
55	273	42	33	36	[illegible]	[illegible]	[illegible]	[illegible]	100	1[illegible]	[illegible]	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	C
22	351	76	37	42	3	[illegible]	4.4	[illegible]	[illegible]	[illegible]	-1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-3.01	5.68	3
43	334	51	35	41	3	1.2	3.1	[illegible]	34	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	2
56	277	64	33	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	4	[illegible]	C	0.00	0.00	C
57	18	79	47	47	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	C
58	318	53	32	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	C	0.00	0.00	C
59	6	57	39	41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.2	7	[illegible]	C	0.00	0.00	C
60	200	48	36	33	[illegible]	[illegible]	[illegible]		100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00	C
61	351	62	41	43	[illegible]	[illegible]	[illegible]	[illegible]	34	[illegible]	[illegible]	4.1	[illegible]	[illegible]	1[illegible]	0.00	0.00	C

VOL SCAN	HHMM	AREA KKM2	WFLUX KNT/H	NEAR CELL	NEIGHBOR CLST	CONT	ACT VOL	NO [illegible]	NO [illegible]	VELOCITY KM/S	KM/S	TRK NO	CLS CTR	CNT CTR	G C	OVER				
4	1551	5.2	31.25	6.[illegible]	17.0	0.0	140	24	10	10.2	5.1	355	61	116	0	0	0	0	0	0